# Smithsonian

*July 1989*

The National Zoo at 100

Rare golden-headed lion tamarin is a recent arrival (p. 26)

This Fourth of July
have something really impressive to display.

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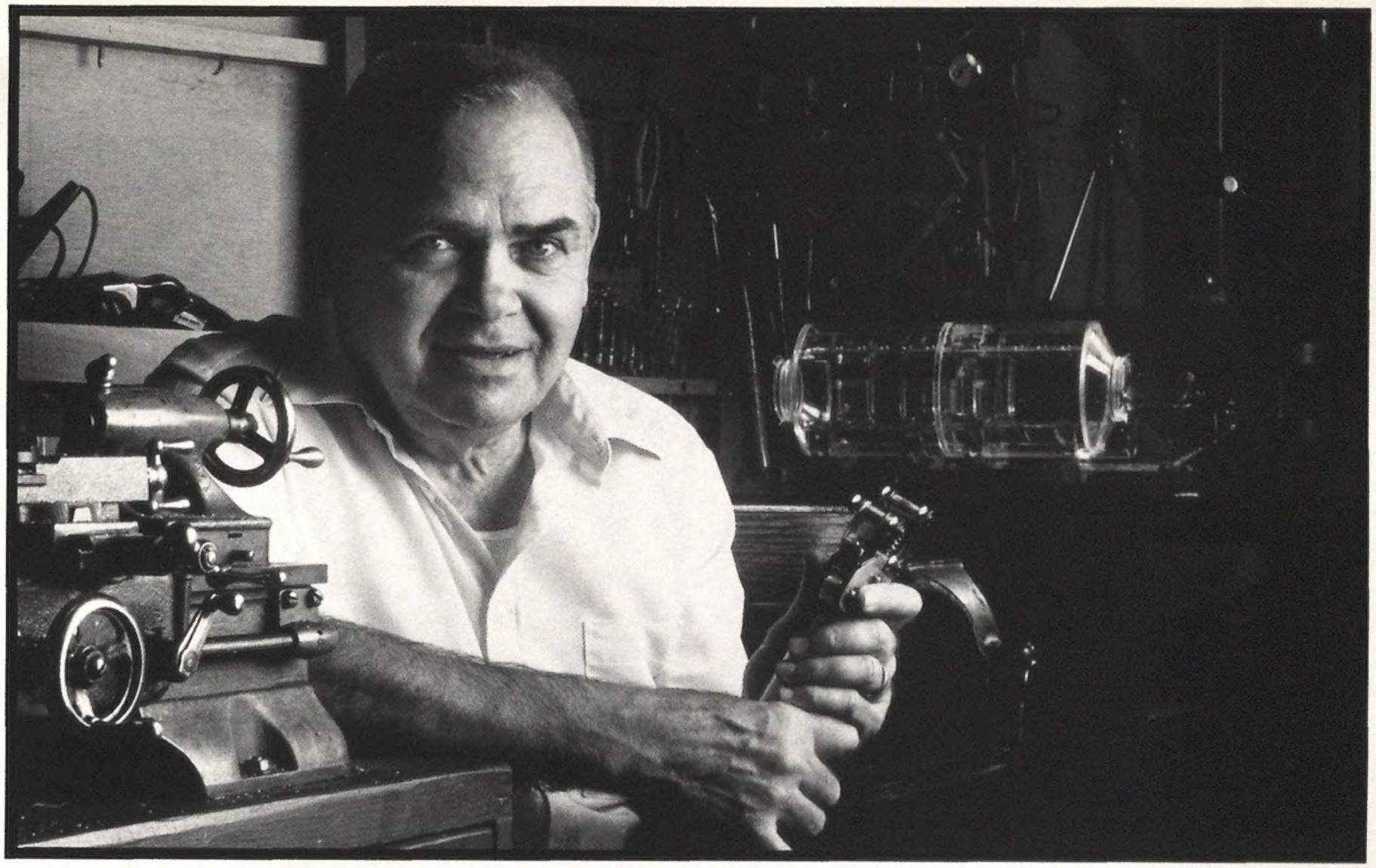

"It's not easy for an astronaut to build anything up there...what they really needed was a fastener that would help them put those space structures together quick and easy.

My job is solving these puzzles. This time I designed a self-aligning bolt for them. But I couldn't help thinking those gloves they wear could be trouble. So I went home and did some work on my own. Cut up a cookie sheet and found an old gear in the garage—used them to make some modifications on a cordless screwdriver. Turned it into a push-button wrench that'll let anybody—astronaut or robot—screw that bolt together in seconds.

If you keep on thinking, one interesting idea just naturally seems to lead right on to the next one." *—Earl Cooney, Space Station, Industrial Engineer Advisor*

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*July 1989*

# Smithsonian

Volume 20, Number 4

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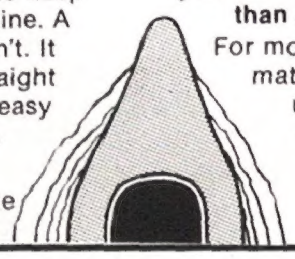

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*Secretary Adams' comments*

# *Smithsonian horizons*

*Nowhere are the shortcomings of our educational system more critical than in the area of science and technology*

I recently had the privilege of attending a meeting of some 75 leading young researchers in the natural sciences that was organized by the National Academy of Sciences and Engineering at its Arnold and Mabel Beckman Center in Irvine, California. The organizers, themselves a group of outstanding younger scientists that included winners of the National Science Foundation's prestigious Waterman Prize (candidates for which must be 35 or under), had selected the other participants from among their most promising peers and successors. In fields ranging from astrophysics and fundamental particle physics to organic chemistry and neurobiology, they sought to share the goals as well as the substance of their research findings with one another. While details were frequently obscure, the overall quality of many presentations, and of the interchanges following them, was dazzling. If you have wondered whether the best of American science was continuing to reproduce itself, those three days of meetings would have gone a long way toward erasing your doubts.

But how long can this flowering at the summit of our scientific enterprise be sustained when its roots are being more or less systematically deprived of nourishment? Part of this is a familiar financial problem: past successes breed new and promising research beginnings, at a rate outstripping (especially in an era of deficits) the availability of support. But there are human roots that also are being malnourished. The shortcomings of our educational system are now widely recognized (*Horizons*, September 1988), and nowhere are they becoming more critical than in science and technology.

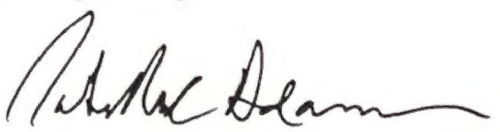
Many efforts have been launched to improve teacher supply and quality, and to improve and modernize courses. But as the National Science Foundation reports, "even our best mathematics students have the lowest achievement scores of any country for which comparable data are available." Findings recently issued by the National Assessment of Educational Progress (NAEP) reflect a prevailingly low proficiency of primary and secondary school students in applying and reasoning with scientific information. "Only seven percent of the nation's 17-year-olds have the prerequisite knowledge and skills to perform well in college-level science courses."

Similarly in mathematics, NAEP acknowledges that improvements in performance over the past decade cannot mask the fact that "the gains have been confined primarily to lower-order skills." Although losses during the '70s now are being partly redressed, we have yet to regain the general performance levels of two decades ago. Black and Hispanic minorities, who will constitute a steeply increasing proportion of our labor force in the future, have narrowed the earlier gap but remain at significantly lower levels. Among women, too, relative improvement during high school years leaves a gap that is yet to be closed.

These dismal standards of precollegiate preparation probably have contributed to a long-term softening of college curricula. Even a number of our premier institutions have substantially reduced the required science portion of liberal arts programs, while also introducing courses of lowered rigor and mathematical content. It is hardly surprising, then, that graduate-degree enrollments in the sciences can be maintained only by relying increasingly on foreign students (already more than 50 percent of those earning doctorates in our math and engineering programs), no more than half of whom are expected to remain in this country.

Down this road lies real trouble. Can informed decisions be reached if the scientific-technological input required for them rises without commensurate gains in public understanding? Industrial research departments may produce outstanding innovations, but will managers understand them sufficiently to introduce them? It has been perhaps our greatest advantage in building and retaining our industrial strength and quality of life that we support more scientific research and development than Japan, Germany, France and the United Kingdom combined. But will we be able to sustain this stimulus, let alone fully utilize it, as the number of our scientists and engineers falls? Almost certainly not. Richard C. Atkinson, president of the American Association for the Advancement of Science, recently has estimated that by the early years of the next century our production of PhDs in the natural sciences and engineering will be insufficient to fill even 60 percent of the aggregate demand in the academic, public and private sectors.

We hear a lot these days about literacy, but we should recognize that it is a moving target. Cultural literacy without a significant and growing component of scientific and technological literacy is, for our era, as unimaginable as our civilization is without its scientific and technological aspirations and underpinnings.



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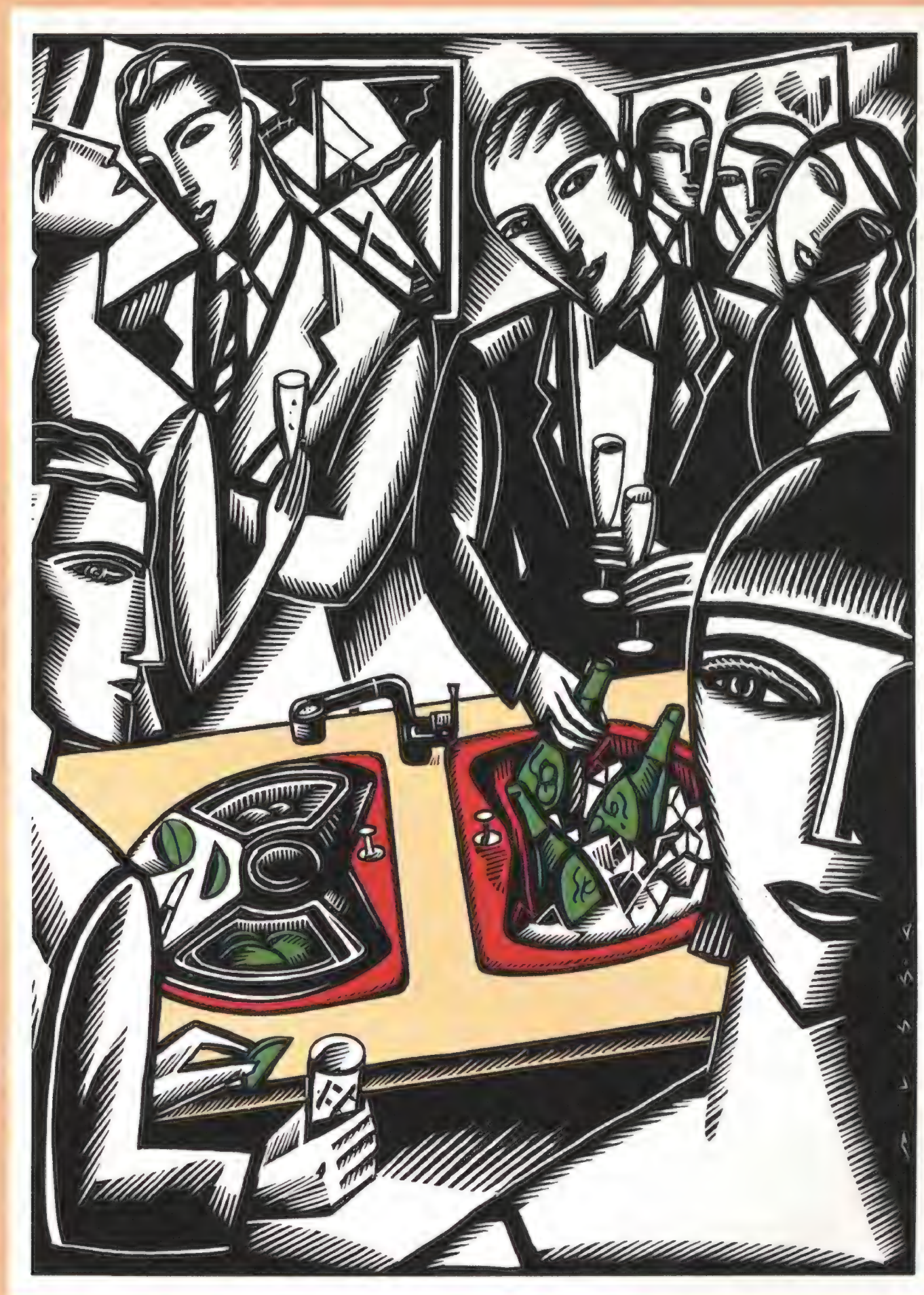

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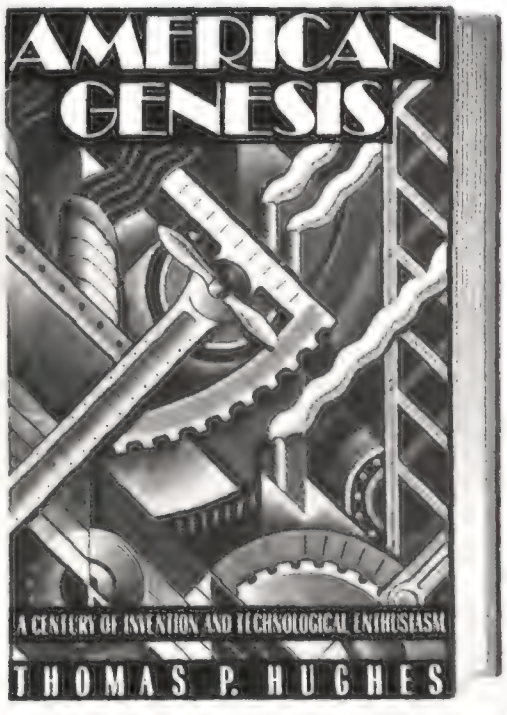


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# *Letters to the Editor*

## *Kites*

Dear Sir: My son and I are all-season kite fliers here in the Northeast, where there's a real kite resurgence—especially among adults. We've flown every month since December—if the sun's out and the wind's up, we're out. Even if it's cold and there's snow on the ground, we just bundle up and go fly.

Recently Kevin and I enjoyed a windy afternoon of stunt-kite flying. Remembering the Smithsonian's kite festivals, I mentioned that I should ask SMITHSONIAN to publish a feature on modern kites and kite flying. Then, yesterday I received your May issue. Someone out there must have been reading my mind.
*Brad Harrington*
Rochester, New Hampshire

Dear Sir: Your article evoked memories of 50 years ago and summer holidays on flat Normandy beaches. Many were the happy hours I spent with a four-foot red box kite much like *Sky Phases,* so high it seemed to have disappeared, but pulling on my hands and speaking convincingly of its powerful presence.

And then other memories of spring in northern India 20 years ago, as a medical missionary. The beauty and challenge of kite flying possessed our village children. Sometimes kite lines would be embedded with powdered glass and the kites maneuvered in an attempt to sever a rival's cord—easier said than done. But when free-flying severed kites blew by, youngsters would race along in hot pursuit, crying *"Putung, putung!"*(in Hindi, "Loose kite!").
*The Rev. David H. Barnhouse, M.D.*
Pittsburgh

Dear Sir: Camping near the ocean in Baja California, I used to get kites up, usually three, tie them to the cars and let them wave all day. My companions thought I was into my second childhood. Your article will prove to my great-great-grandchildren that I wasn't.
*Robert G. Thompson*
San Diego

Dear Sir: I would like to pay tribute to some great kite fliers who aided me in founding the American Kitefliers Association and its *Kite Tales* magazine in 1964. Among them:

Domina Jalbert, one of the greatest aerodynamicists of the century—a parachute based on his kite has been used by the military and by skydivers; Francis M. Rogallo, whose *Parawing* was precursor of the hang glider; David Checkley, kiting ambassador of goodwill who established lasting friendships between Japanese and American kite fliers.
*Robert M. Ingraham*
Silver City, New Mexico

## *Money*

Dear Sir: Ever since childhood (I am now 11) I have had many "money questions." One came up again after reading your article. Where does the money first go after it is printed or minted?
*Eva Peterson*
Fort Meade, Maryland
*New currency is shipped to the 12 Federal Reserve Banks, then put in circulation through the country's various banking institutions.* Ed.

## *Johnstown Flood*

Dear Sir: Johnstown was not the worst flood tragedy in American history. In the great Galveston, Texas, storm, September 8-9, 1900, between 6,000 and 8,000 people lost their lives. Galveston was then, as now, a tourist attraction and a port of some renown, and hundreds of strangers who happened to be in the port and city at that time, as well as residents, lost their lives. Many were never accounted for, because of the ensuing panic and confusion.
*Ernest E. Morrison*
Lubbock, Texas

Dear Sir: Floods and their aftermath certainly are occasions for bravery, sacrifice and suffering—which in many floods are needless or excessive.

Johnstown, like many other river-

valley communities, does not learn from experience, and our government's policies discourage learning. With flood insurance, Corps of Engineers projects, and state and federal subsidies for building and rebuilding in the floodplain, we perpetuate the misery and cost of inevitable natural events. Washington, D.C. is no exception. In 1972 I piled sandbags at Fort NcNair to avert the rising Potomac.

While I am as attracted to water as the rest of the human race, living in a floodplain is something we can and should discourage. Both social attitudes and policy should shift away from the "I will rebuild" stand to "It's time to move to higher ground."

*Andrews L. Tolman*
Readfield, Maine

Dear Sir: Another hero of the flood—famous at the time, now nearly forgotten—was Daniel Hastings, Pennsylvania's Adjutant General. On the scene within 24 hours after the disaster and the highest-ranking authority in the area at the moment, he became de facto, later official, head of cleanup operations, unhesitatingly wading through mud, pulling bodies from the wreckage and serving as a rallying point for the anguished community. Several hundred telegrams from families of victims, anxious for news of their loved ones, were all answered by him. He earned laurels nationwide for his patience, organizational skills and clearheadedness in the wake of terrible suffering. Clara Barton said of him, "The gallant soldier could not have been more courteous and kind." He successfully ran for governor of Pennsylvania in 1894, but upon his death in 1903 was eulogized not as chief executive, but as the "hero of Johnstown."

*Linda A. Ries*
Division of Archives and Manuscripts
Harrisburg

## *Home aquariums*

Dear Sir: In order to satisfy the desires of rich Americans for more and better exotic fish, native collectors all over the world are destroying the coral reefs. Live coral in the tank comes from reef destruction. The cyanide being used in the Philippines kills ten fish for every one captured, and kills the coral as well.

Collectors of exotic wild-captured fish are in the same class as ivory collectors, fanciers of rhino horn and those

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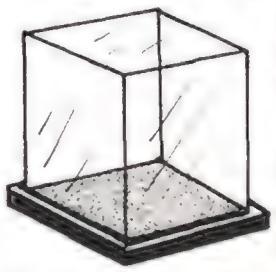

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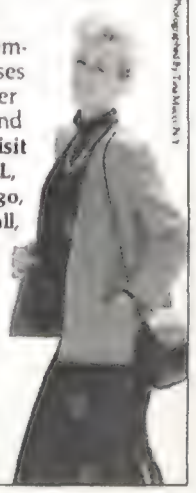

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who just must have a leopard coat. Laws should prohibit importing wild-caught saltwater fish, and captive breeding certification should be required for all tropical-fish sales.
*Peter E. Kane*
Churchville, New York

## *Frederick Funston*

Dear Sir: In 1955, at age 8, I crossed the Pacific, heading from Seattle for Yokohama with my mother and sister on the USS *Frederick Funston* to join my father at an Air Force base in Japan. No ocean travel since then has approached that experience. For me, shipboard fun has always been spelled F-u-n-s-t-o-n.
*Martha E. McDonald*
Decatur, Georgia

Dear Sir: Your article rekindled memories of the general's namesake. The USS *Funston*, originally an Army transport, was converted early in World War II to an amphibious assault transport.

I joined her as ship's chaplain after the battle of Sicily. She participated in the Salerno landings and, after taking paratroops from Italy to North Ireland for the Normandy invasion, was returned to the States for refurbishing for the Pacific campaigns. At Saipan, Guam, Leyte, Lingayen Gulf she not only landed Marines and Army but became an auxiliary hospital ship for casualties from the beaches. Her final battle was Iwo Jima, where her captain, C. C. Anderson, suffered the tragedy of receiving his only son, Sgt. C. C. Anderson, USMC, as a casualty. I buried young Carter on Iwo.

At the close of the war the *Funston* became a troop transport. Each evening the skipper allowed me to broadcast to the ship's company and troops over the P.A. system. I often recounted stories of General Funston's amazing exploits. He became an inspiration and a challenge to the men of the new "Fighting Freddy," as the ship was affectionately called.
*John D. Wolf*
Valparaiso, Indiana

## *The object at hand*

Dear Sir: The minié ball is distinguished from other bullets used in small arms during the Civil War because the base is concave, not flat as you said.
*Carlyle S. Smith*
Lawrence, Kansas

*Mr. Smith is correct. Most bullets in the log are indeed miniés, but our description of the shell was inaccurate.* Ed.

## *Neckties*

Dear Sir: Sitting here wearing my favorite tie, I note that you say the neckware industry is a billion-dollar business. It's interesting that the writer makes such fun of it. If Mr. Wolf doesn't want to wear a tie, that's *his* lack of good taste.
*John T. Beis*
Atlanta

Dear Sir: Founded a number of years ago, the National Association for the Demise of Ties does not publish a newsletter, nor levy dues, nor lobby. It just issues membership cards to like-minded "workers of the world."
*David Berman*
New York City

Dear Sir: I have no objections if a fellow wants to wear a hair ribbon, earrings, hippie beads, a bone through his nose or a necktie. But I resent it when he starts demanding that I too be made to follow his ridiculous whim. It has long puzzled me that supposedly grown-up, mature individuals attach such tremendous importance to whether or not you have some silly rag around your neck.
*Howard J. Hanson*
Federal Way, Washington

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# *Around the Mall and beyond*

Just before the National Air and Space Museum opened in 1976, I was taken in tow by one of its curators and led through what was described to me as the prize of all the 23 large and small galleries—Gallery 213. Its title was a put-off—"Flight Technology"—but it was a wonderfully imaginative exhibit. It described how humans have used their brains to fly almost as well as (and a lot faster than) the relatively brainless birds that are so annoyingly good at it.

There we followed the adventures of Ace Blue and Wheeler King, two puppets whom we met when they were boys in knickers, watching Wilbur and Orville Wright fly. We tracked them through their brave new world of wind tunnels, engine cowlings and streamlining until, in the 1930s, they helped design a record-breaking plane. It emulated, of course, Howard Hughes' H-1 racer, which hung from the gallery ceiling, slender and gleaming.

When Gallery 213 closed some time ago, I wondered what could possibly fill it with the same kind of magic. In May, I found out. The gallery reopened to show us, spectacularly, how computers have taken over from Wheeler and Ace and Howard Hughes. The new exhibit, "Beyond the Limits: Flight Enters the Computer Age," has jumped 60 years ahead of the 1930s into an age when computer brains do better at flight than humans and birds combined.

Gallery 213 is at the eastern end of the museum on the second floor. Entering, you trace the sudden surge of the computer revolution: bulky and fragile glass vacuum tubes, then tiny transistors, then the dime-size microchip that holds the power of a million transistors. You see how the creaky old integrated circuitry of the Minuteman ballistic missile led to the mysterious "black boxes" that now help us fly.

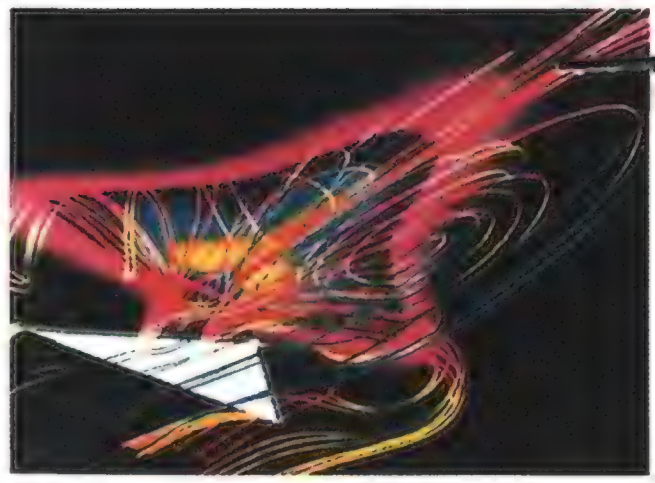
Back in those distant days of Ace and Wheeler, aeronautical designers would sketch their ideas, then get them mocked up as models. They'd try them out in a wind tunnel, and generally have to go back to the old drawing board to get them right. In this new gallery you will meet CRAY-1, a superpowerful computer that will gladly help you design your plane, tracing accurately and at lightning speed the stresses it will meet as it hurtles through the air.

One example of the talented work performed by such supercomputers is the Grumman X-29, an extraordinary experimental plane that graced the cover of our sister magazine, *Air & Space/Smithsonian*, last year. The idea behind it was to add what fliers call "quickness"—that is, rapid response and maneuverability—to the blazing speed that's necessary for a modern fighter.

Grumman's designers knew that forward-swept wings would make the plane both fast and maneuverable, so they sketched a design and turned it over to a supercomputer, asking it to check out the strange new configuration and see if the plane would actually stay in the air.

"Right," said Supercomputer, and, taking the place of a wind tunnel, dashed off the lines of force that would affect the plane's flight. The designers modified and tested some more. The result is a fighter so radical that it stuns anyone remotely interested in aviation.

Look overhead in Gallery 213, and you'll see for yourself. A full-scale model of the X-29 hangs above the displays just as the Hughes racer did. The new fighter, white with red and black



Supercomputer-generated image shows airflow over delta wing as it lifts off.

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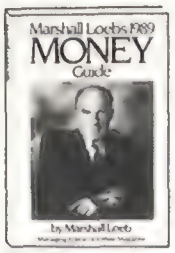


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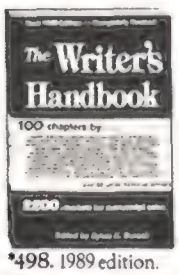


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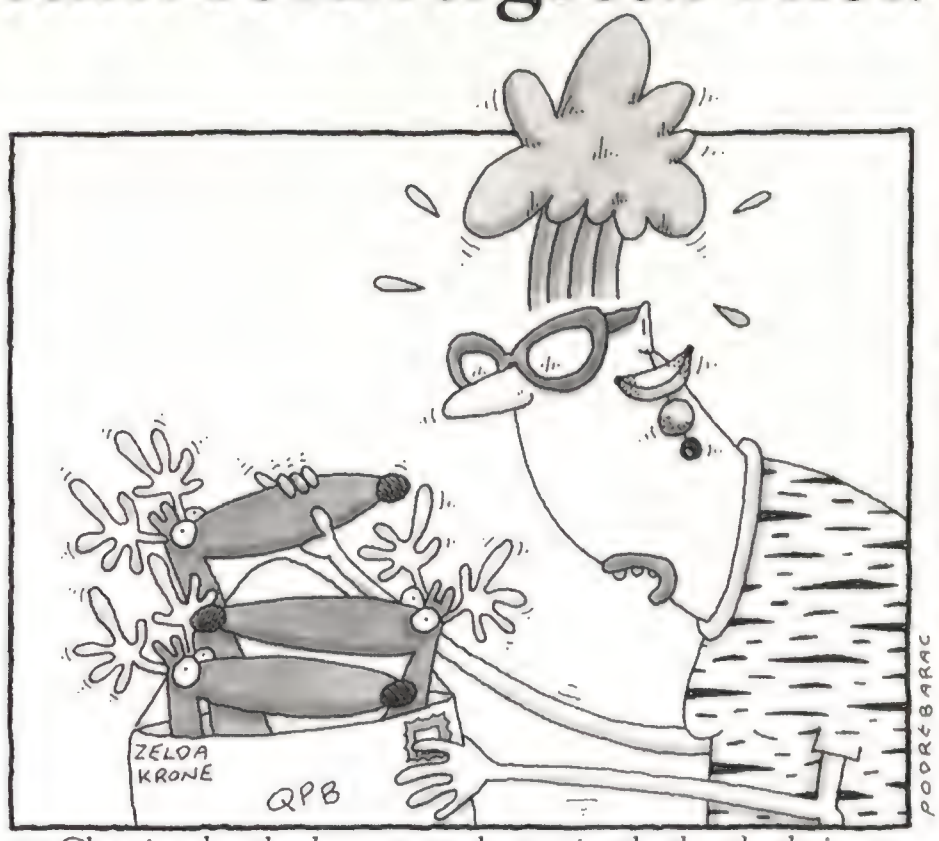


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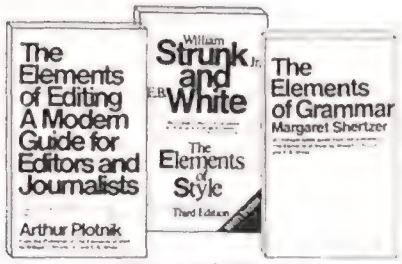


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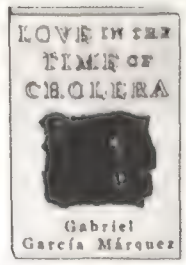


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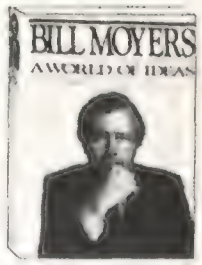


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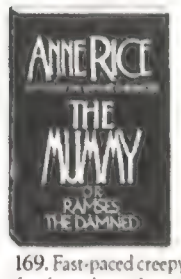


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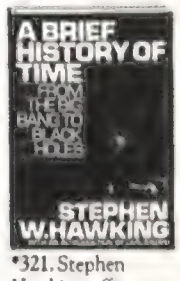


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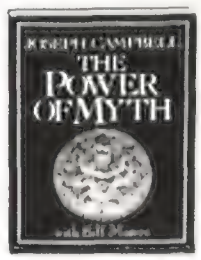


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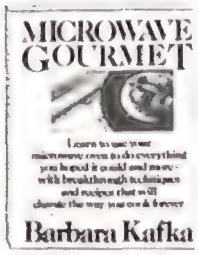


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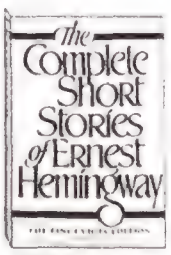


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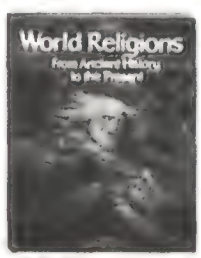


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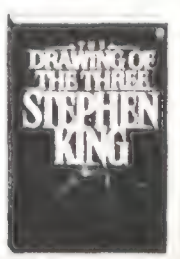


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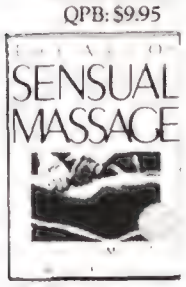


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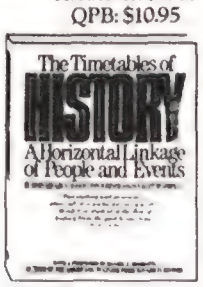


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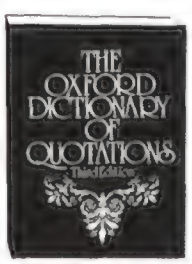


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stripes, looks as slick as a half-sucked candy cane. Even when it's motionless it reeks of speed. It also seems at first to be going backward.

Yet those slender wings, reaching eagerly forward instead of sweeping back, are old stuff. The Germans tried them in World War II and didn't like them. And that stubby canard—the short winglets jutting from the sharp nose—isn't new either: the Wright Flyer has a canard of sorts, and designer Burt Rutan revived the idea for his speedy little sport planes and also for the famous world-girdling *Voyager*, now hanging above our museum's Independence Avenue foyer. Even the composite materials, strong, smooth and light, that went into the X-29 are now familiar. It's the successful combination of all of these that's new.

But in designing aircraft and space vehicles, you don't get anything without giving something up. In this case it's stability. Back in World War I, aeronautical engineers learned that stable, easy-to-fly planes couldn't flick around the sky with the agility that a fighting plane must have. To get that quickness, you needed an unstable plane, tricky to handle. World War II fighters fully bore out that discovery. The very best of them were nervous little ladies that twitched in the air with the pilot's every heartbeat.

As for the X-29, it's fast and nimble, all right (performance remains a secret, though a film in the gallery shows it twisting and writhing with incredible speed), but it's simply too unstable for a human pilot to control. Three onboard computers do the job. They're all alike, each capable of flying the plane. Between them, they maintain stability by reacting to the forces on the plane far faster than the pilot ever could. If one of the computers disagrees about what correction it should make, the other two can outvote it.

Oh yes, about the pilot. He sits there and moves the controls that tell the three computers where he'd like to go and what he'd like to do. The three follow these "suggestions" as best they can, while keeping the plane from stalling in a high-speed turn, or snap-rolling, or tumbling head over tail the way some dicey little World War II fighters would do if you yanked them around too mercilessly.

The X-29's computers instantly correct every wobble, every momentary loss of lift, every tremble at the edge of a high-speed stall. They pass the appropriate message to the control surfaces, which respond instantly with exactly the right movement. If you want to see how controls can be ordered about by computers, you must visit Gallery 213's most popular display—the robot (above).

Computer-driven robot folds and flys a paper airplane every five minutes.

After pausing to stare at the mock-up of a space shuttle cockpit, an old-fashioned Link trainer, a number of calculators and computers, you'll find the robot working away before an audience of openmouthed viewers. It pays no attention to them and is unconcerned that the floor in front of it is littered with rectangular paper airplanes. It's been programmed for a career of making and flying them.

The robot is a bright-colored figure with two armlike extensions on each side of a square "head." With pincers "fingers" it selects a pale-blue sheet of paper. Slowly and carefully it rotates those fingers, rolling the long edge of the paper over six times. It extracts its left pincers and lays the paper on a firm bed. Then, when the left pincers push a button, the square, flat head drops to crease the rolled part, forming a rectangular wing, bulky and heavy along the leading edge.

The robot then shifts the sheet, holding it with small suction cups, and creases it again, right across the middle. This gives the wing a V shape—the dihedral that adds lateral stability. Two more parallel creases follow, the head folding down on itself with a hiss like a tailor's old-fashioned press. This fashions small winglets that droop from the wingtips for directional stability.

Now for the test flight. Deliberately, the robot's right extension grips the angular little flying wing and brings it up and back like a slow-motion film of a quarterback cocking his arm for a pass. Finally the robot's arm moves forward, releasing the plane.

The one I watched flew beautifully, but swung to the right and headed straight at me. I caught it and read some information about the exhibit that was printed on it. On one edge it said "Please do not litter." Then I tried the little plane and realized that I didn't fly it as well as the robot.

Wandered off to a couple of interactive displays and tried my fading skills as a pilot. I sought to emulate electronics in maintaining the direction and purpose of an aircraft shape on a screen. I failed miserably at one such test and passed another only because a built-in computer stepped in to save me.

This disturbed me. I had just returned from a riotous reunion of my old fighter squadron, during which we noisily reenacted, with many hand gestures, our moments of aerial greatness—and luck—back in the good old Forties. Now I was being reminded gently that I couldn't outfly a damn machine.

I called Paul Ceruzzi, curator of "Beyond the Limits," and asked the inevitable question that concerns every onetime pilot: Is our old, hard-learned craft finished? Are we in fact an endangered species?

"Not yet," said Paul soothingly. "Computers fly strictly as they're programmed, and so far they can't be prepared to foresee absolutely everything. A pilot still must be in the cockpit in case some new situation crops up and the computer's rules need to be bent or broken to save the plane."

I felt better, but still shaken. Back at home I took a sheet of paper and made the same flying wing as that robot's. I took longer than the robot does and I didn't fly it as well, the first time. I modified it, tried again and got some nice flights—no pull to the right.

But I realized that I had wasted much of a morning on one stupid little plane, while the robot, back there in Gallery 213, was turning out about 24 of them. I chucked mine around my workroom once more, and this time it landed in my wastebasket.

I just left it there.

*Edwards Park*

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Navigation was also in China's strong suit. From 1405 to 1433 vast Chinese fleets, which would dwarf much later European expeditions, were already exploring and opening up trade routes westward. By 1431

View of the Imperial Court, Beijing, Anon. 17th Cent., Bibliotheque Nationale, Paris

a fleet of sixty-two ships and 28,000 men had reached the east coast of Africa. It was only a matter of time before the Chinese discovered Europe.

Then, in a sudden policy reversal, the Ming Emperors halted all further voyages and began to foster an atmosphere of xenophobic conservatism. Science and technology decayed. Trade became passive. And the next five centuries saw China become one of the world's exploited nations.

The United States now also finds itself at a critical time in history. So many domestic and defense needs make investment in space exploration seem, by comparison, of lower priority. The funding of our orbiting space station, indeed, our whole space program, seems to be politically in doubt.

One thing that is inevitable, though, is that humans will continue to reach out into space. It is in our nature. And whether space is explored by the United States or the Soviet Union or Europe, it will be explored.

Had the Ming Emperors not hamstrung China five hundred years ago, history undoubtedly would have taken a dramatically different turn. But their moment was lost.

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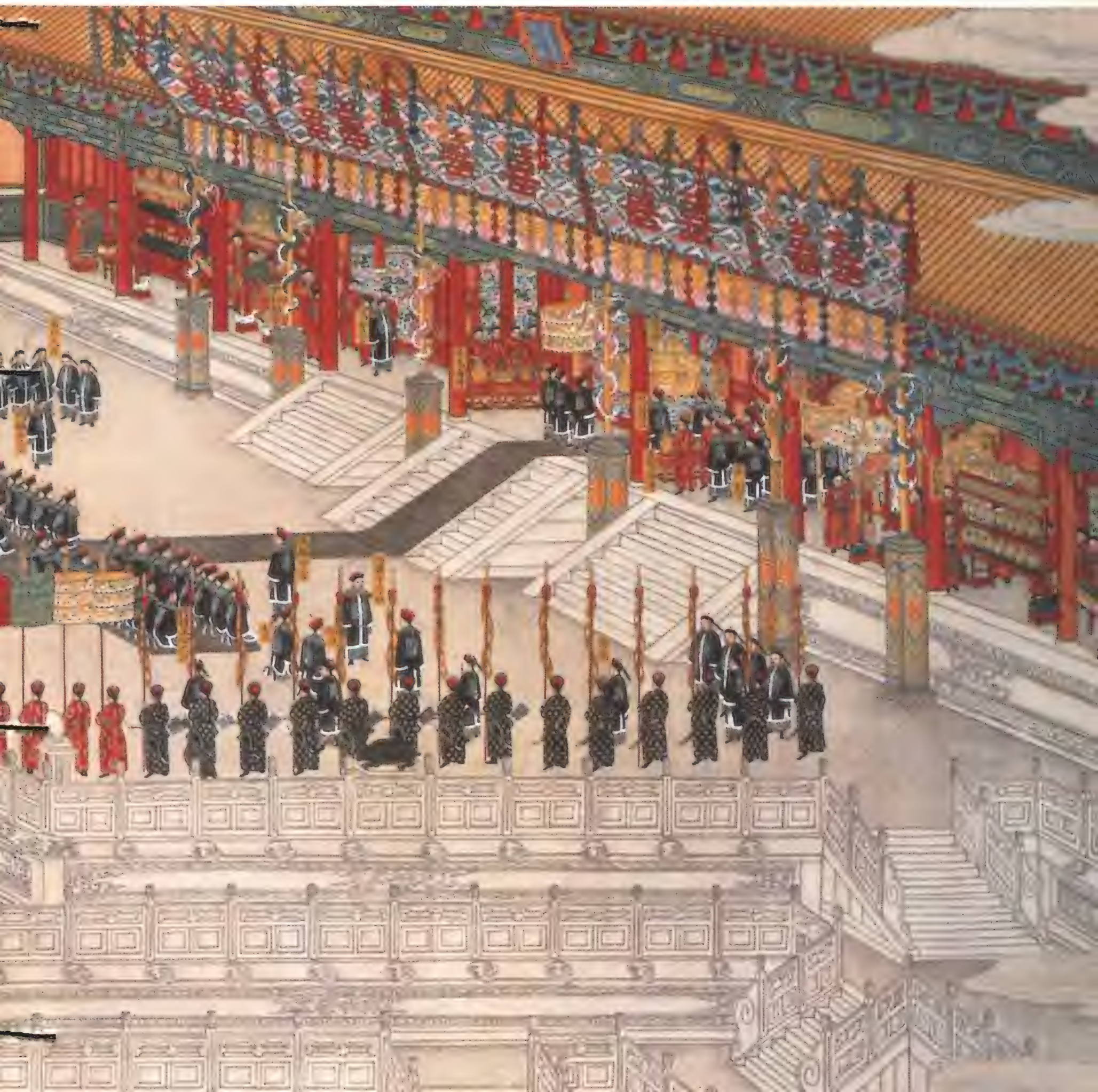

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# *Phenomena, comment and notes*

*Here's a way to get fit, save the planet, make our cities livable, have a little fun—and it's all for free*

"It would kill any of the young men of the present day to attempt such a walk; it must be four miles, or two, or some immense distance."

Those lines, spoken by a noblewoman in Emily Eden's 1830 novel, *The Semi-attached Couple*, somehow strike me as funny in this day of three-hour flights to France—funny at least until the next time I find myself in a 4,000-pound car carrying four pounds of milk four blocks. On the days when I drive to work (the days when there is not time for the subway: mass transit it may be but rapid transit it is not) my mind is too busy reviewing the roll call of anxieties to take heed of any other driver not actively trying to run me off the road.

And then my father will be up for a visit from South America, I'll take him downtown in the morning, and invariably he is stunned at the sight of all those cars—almost every one carrying one human being and no more. He lives in a place where people live environmentally sound lives for the wrong reason: they are too poor to do anything else. When he has an empty jar or bottle, he simply sets it outside the garden gate. Within five minutes it has been recycled, pressed into immediate service. Even among the ranks of those a lot higher on the money tree, hardly anyone drives to work alone.

Actually I was a little stunned myself when I first started working in Washington. I would come out of my build-

ing at the end of the day to find the sidewalks almost deserted. Our magazine offices are in a building on the Mall, which of course is a special case: aside from the concession stands, this is a noncommercial district. That means that it is a desert as far as human amenities are concerned. Nowhere can you get your glasses fixed, pick up some flowers or buy a bottle of aspirin.

Now the Smithsonian itself employs only a few thousand people. But at the west end of the Mall and across the avenue on its south side are major federal buildings. Another block south are more temples of bureaucracy. Altogether we are talking about a fair number of people. Yet when you come out of the back of our building at 5:30 or 6, and look across the street to where all those people have been spending our tax money all day, there is hardly a soul in sight. The sidewalks are almost empty. Everyone either disappears underground to catch the subway, or gets into a car and drives away. Even those who want to get together to discuss the latest managerial madness get in their cars and go somewhere else to do it. After working in New York, where the sidewalks are alive, this absence of people produces a weird feeling. You begin to wonder if you have stumbled into one of those movies in which something terrible has happened to everyone except the hero.

The good news is that we can turn places like Washington into real cities and at the same time ease two national problems without spending a penny. As a nation we worry about global warming; we fear the ozone on the ground that injures our trees and our lungs, and the thinning ozone miles over our head that no longer protects so well against ultraviolet radiation. We worry about the nitrogen and sulfur oxides that fall again as acid precipitation and the carbon monoxide that crowds the oxygen out of our red blood cells. We're doing it to ourselves, every time we put the key in the ignition and turn it.

As individuals we also worry about our health and the urgent advice of the authorities to do grim penance for the french fries of long ago. We nod our head and tell friends we really should get out and jog, join that health club, buy a $600 machine for the bedroom. But we are rushed this morning, tired tonight. Next week for sure: we're going to get right on it. And sometimes we do, and then drop out.

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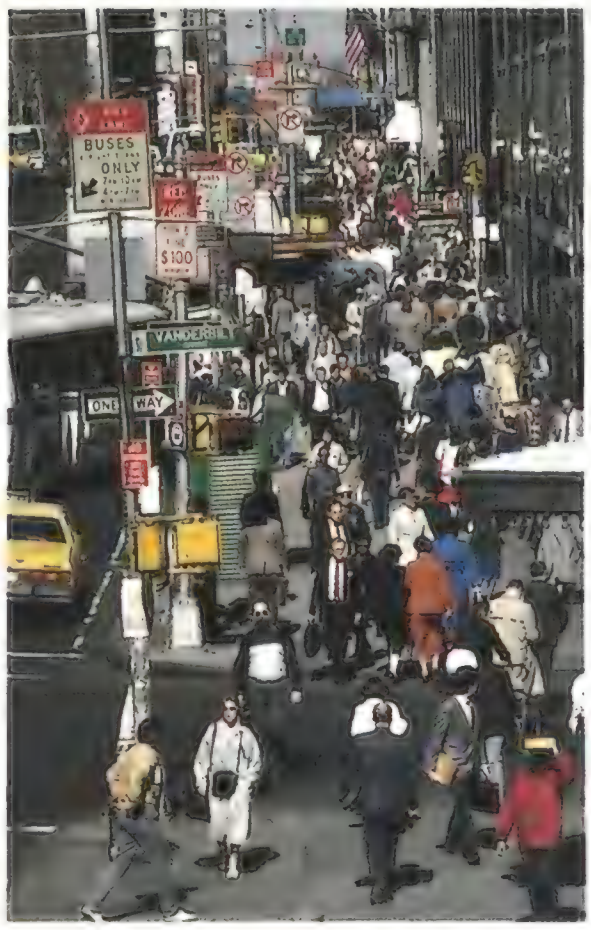
Let's leave weakness of character out of this. People drop out because that kind of exercise is boring, makes you ache and, if you don't happen to be a gazelle anymore, somehow rubs your nose in your own deterioration. It has no purpose beyond the motion itself. On one of my very few excursions on horseback (Cocoa, wherever you are, thanks for keeping us right side up!), I liked it when the wrangler stopped snickering long enough to explain that while Eastern riders do it for show, out there in the West people ride horses to get somewhere.

I've always thought it made more sense to use gardening and yard work for exercise rather than pay to go to a club and pull weights on wires that run through pulleys. When you finish your garden "workout," you have accomplished something. News reports years ago of Chinese office workers being forced outside to shovel snow struck me as an inspired idea. What an incredible antidote for the post-power-lunch mid-afternoon slump.

Now what I'm driving at here (pardon the verb) is a way to exercise that does not require adding a whole new, unpleasant chapter to each day. Something that can be done without special equipment or going to a special place. Something that lessens the damage being done to the planet we love. It seems that you don't have to get your pulse up to some very high rate and keep it there for so many minutes so many times a week for exercise to do any good. Any exercise is good for you, we now learn; one of the best is just plain walking. All we really have to do in cities is what the National Park Service is forever urging us to do when we are out in the middle of nowhere: get out of the car.

The kind of walking I'm talking about has nothing to do with hardship and self-discipline. I'm talking about city walking, a delight for body and mind. Just suppose you found yourself walking five miles a day. Not all at once, mind you, but a little in the morning, a walk at lunch, a trip to the post office; later a walk part of the way home, even down to a restaurant or the movies in the evening and then home again. Find yourself noticing cloud formations or swifts spiraling down into the library chimney, bats flashing under a streetlight. Check the bookstores, the notices stapled to telephone poles. Find that



Pedestrians, and merchants who cater to them, give cities a special flavor.

faces are considerably more interesting than bumper stickers.

Paradoxically, being on your own two feet is restful. No one is climbing up your back, leaning on a horn designed to blast an opening a mile ahead while doing 130 on the Autobahn. If something catches your eye, you can stop without being rear-ended. You discover that you do not have to be training for the Iron Man Triathlon to release a few endorphins in your brain, letting the sun come out in your mind. How many times have I started out to walk somewhere, feeling tired and irritable, begun to think the whole idea was a dumb mistake, then found that despite myself the slump was even coming out of my shoulders and I was deciding not to have that troublesome writer done away with after all.

Governments dither, but there is nothing to keep us as individuals from voting with our feet. We can do something about global warming, and feel better for doing it. Each time one of us walks someplace instead of driving, that much less poison has been injected into the air we all breathe. (Actually the benefits are multiple. One less car means that the rest of the traffic will move that much more quickly and burn less fuel.) Now suppose two of us walk someplace instead of driving. What if 100 million of us did it just once a day?

As time went by, a third benefit would accrue. Paradise is not now upon us. The streets of Washington, like those of most other cities, are not yet a permanent festival, promenaded by philosopher kings. In Washington, the tide is still going out. The corner restaurant where you could sit in a booth for hours, the bakery where people lined up for the strawberry pies, the health food store that was forbidden by law to use the word "health" in its name but sold a ton of the No. 7 salad (chopped carrots, raisins and cottage cheese, with a mayonnaise-and-buttermilk dressing) are all disappearing as the old buildings come down and great glass blocks go up in their place. As urban sociologist William H. Whyte says (SMITHSONIAN, February 1989): "... prosperity [is] lowering our real standard of living." But if hordes of us take to the sidewalks, we can return these mean streets to their highest function, the bringing together of human beings.

When we reclaim them, the sight of armies of potential consumers on the march will not be lost on entrepreneurs. They will become placer miners, dipping into the stream for gold. After a couple of quick trips to Rome what I remember most fondly is not the churches, the shops or the Colosseum—but the bars. These are not establishments devoted to the consumption of alcohol but rather rest stops, places where on the way to work, or home, or your next appointment, you can stop in for a small coffee, a delicate pastry or a sandwich fresh made with whatever is in season. Places where you and a friend can go to talk. There seemed to be one in every block, and it is like having a butler who is ready at any time to produce a little something to tide you over. No one would dream of driving to one; even if you survived Roman traffic, there would be no place to park. You walk there. The day may come when we can walk to one here.

Listen, I'd really like to finish this story, but I've got to get up to 19th and E for a lunch date. I guess I'll walk on over to the Museum of Modern Art of Latin America, then go by Bolivar Pond to check on the ducks. After lunch I'll hike up 17th to pick up tickets for the ball game, and then come back down 15th, past the Boy Scout statue and on back home to the Mall.

*John P. Wiley jr.*

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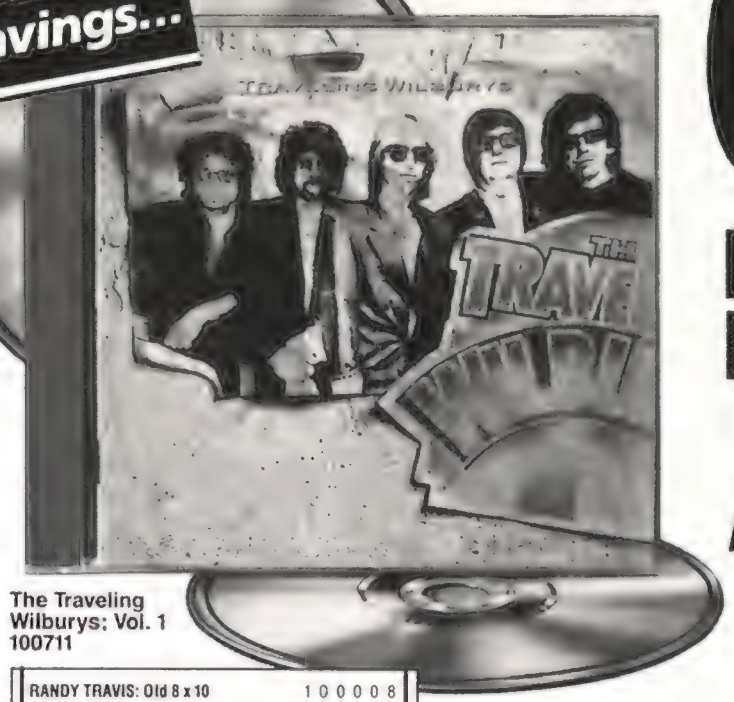

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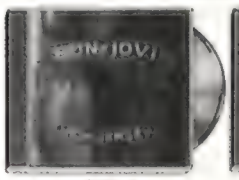

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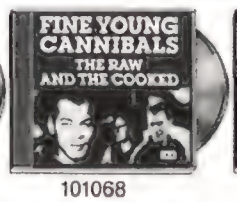

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*By Jake Page*

# From back-lot menagerie to nascent BioPark in only a hundred years

*The National Zoo has grown from a few animals once housed behind the Smithsonian Castle to a park that embodies the diversity of nature*

Dawn. Soon a maniacal chorus arises along Rock Creek Park in the nation's capital, a combination of duets that carries for a mile in all directions. It is accompanied by an aerial dance beyond the talent of the National Ballet or the National Basketball Association. This is Gibbon Ridge, one of many new installations at the National Zoological Park, consisting of huge "flight" cages filled with trees, ladders and ropes on which the siamangs and white-cheeked gibbons swing in highly controlled abandon, seeming almost to fly up to the top, leap some ten feet, change direction in an instant with a casual flick of the wrist, swoop and, as abruptly, drop to the ground to groom a mate for a spell. They are the fastest canopy-living primates when they're swinging. Near the gibbon enclosure is a reproduction of a Ming dynasty painting of gibbons, courtesy of the Freer Gallery of Art, another member of the Smithsonian family.

About a half-mile west, natty wild wood ducks fly out of the trees and land in a newly created wetlands habitat where familiar and exotic waterfowl swim peaceably in dark water surrounded with marsh plants and explanatory signs. The water, one sign says, has been stained black with a dye that doesn't affect the birds but simulates the tannin-rich waters of many wetlands. Overhead, about a hundred wild night herons nest in the trees, regulars here for several years.

Elsewhere, behind the venerable Reptile House, a reproduction of an incised hieroglyphic honeybee beckons you to zoodom's first full-scale exhibition of invertebrates—insects, spiders, anemones and the like—drawing attention to the fact that science knows of 41,000 vertebrate species but has named and described some one million invertebrates. New estimates from the rain forests suggest that there may be as many as 30 million insect species. It is no accident that invertebrates—these "little things that run the world," as one biologist has put it—are now featured at the National Zoo. Its current director (since 1984), Michael Robinson, was formerly a researcher in the tropics, specializing in spiders, among other things. Robinson is presiding over a period of growth at a time when the philosophy and planetary role of zoos has suddenly changed.

A hearty walk from the Reptile House lies a simple paddock with a lived-in look. If it is empty, you need only holler "Grunt!" a few times and presently a mild-mannered Vietnamese potbellied pig ambles out of its barn and across the grass to greet you, tail wagging like a rotor. These pigs are being touted in some quarters as the next popular pet—tamable and affectionate. Be that as it may, Grunt marched in the parade on March 2, 1989, that was part of the National Zoo's centennial celebration. The parade passed along the now nearly complete Olmsted Walk, once a dirt track for carts, now a broad, tree-lined avenue that snakes past indoor and outdoor exhibitions in what is one of the most highly regarded zoos in the world.

It was not always so. In fact, in 1892, only three years after the National Zoo was established by an act of Congress, the Secretary of the Smithsonian was ready to throw in the towel. Congress had slashed a budget request for $73,000 down to $50,000. Here's how bad it was. The zoo asked for a $38 reimbursement for rubber boots for the keepers, pointing out that the boots were being issued in the morning and reclaimed at day's end. It was determined that such a request would require special legislation. The Institution vehemently protested such treatment and the only reason the mea-

Smallest of anthropoid apes, gibbons at National Zoo work out on a lattice of rope ladders and swings.

Smithsonian taxidermist William Hornaday, here with bison calf, opened a small zoo on the Mall in 1887.

In an evocative class-trip picture, immaculately dressed schoolchildren pose at the bear cage in 1899.

ger collection was not disbanded was that Congress did not appropriate the money to do so. What had begun as a farsighted dream had become an orphan's nightmare—and somehow the zoo had to muddle on.

The dream had been that of William Hornaday, an adventurous animal collector and taxidermist who in 1882 became chief taxidermist for the Smithsonian's U.S. National Museum (now the Museum of Natural History). People were always giving live animals to the Institution for the care of which there was little personnel and less money. Because live animals are useful to taxidermists trying to create lifelike poses, the care of these animals fell to Hornaday and his staff. Thus the Smithsonian had a Department of Living Animals, and Hornaday imagined that from this there might arise a zoo.

A Midwesterner, Hornaday had witnessed some of the slaughter of the American bison; one can now imagine the spectacle of these magnificent herds only by watching the migration of wildebeests in Africa. In 1886, he returned from a nearly futile attempt to bring back bison skins for the museum's stuffed-animal exhibits. He dreamed of a zoo devoted to the preservation of these beasts and other North American species on the road to extinction at that time. The Smithsonian Secretary, naturalist Spencer Baird, needed little persuasion, but he died that year. His successor, Samuel Pierpont Langley, was more interested in Man's dream of flying but was persuaded to back Hornaday's idea.

On New Year's Eve, 1887, Hornaday opened a trial zoo with a bear, an eagle, a badger, several bison and a few other creatures behind the Smithsonian Castle. By the following spring, people were thronging to this steamy menagerie, as popular an attraction as anything Washington had ever seen. Also that spring, Senator James Burnie Beck of Kentucky introduced legislation to start the National Zoo. The bill got tangled up in Congress but a confident Hornaday proceeded to seek a site, finding a suitable tract of more than 160 acres along Washington's Rock Creek. The following year, the legislation was reintroduced, this time attached to a vital appropriations bill for the District of Columbia, and it was passed on March 2, 1889. With federal money the land was purchased for the new zoo, to be run by the Smithsonian but to be financed by the taxpayer via funds from the District and federal governments. It was the first zoo established with the express purpose of breeding native wildlife.

Hornaday naturally assumed he would be named superintendent, but Langley claimed he didn't have enough administrative experience to handle the post. Hornaday resigned, a bitter man, and went off to sell real estate in (of all places) Buffalo until, six years later, the newly formed New York Zoological Society hired him to be director of a zoo to be established in The Bronx in New York City. The salary: twice what

*Jake Page, who wrote about the U.S. Postal Service in September, is coauthor of the forthcoming book* Lords of the Air: The Smithsonian Book of Birds.

The youngsters in front offer food to the animals, a dangerous practice that has long since been banned.

William (Blackie) Blackburne, who had handled big cats for a circus, was the zoo's first head keeper.

the starting salary had been for the job he didn't get in Washington. Hornaday began to build that zoo into an organization that earned the jealousy of the National Zoo until only the past few years.

Secretary Langley meanwhile appointed Frank Baker, a comparative anatomist, to run the zoo in Washington; and he in turn appointed a fossil collector as his assistant. These two men were inexperienced in handling live animals but, in what some people looking back today consider a miracle of judgment, they hired a man named William Blackburne as head keeper for $83.33 a month. Blackburne had handled the big cats for the Barnum & Bailey Circus and was an animal man through and through. On the day he accepted his job, he also got married, promising his bride he would settle down in one place for good and quit drinking.

Until he retired 52 years later, Blackie never took a day off. Among other duties, he served as zoo veterinarian; and with his booming voice and imposing stature, he ruled affairs at the zoo with an iron hand. One day, a keeper approached him to request a day off to get married. Getting married, Blackie replied, takes ten minutes. He kept Galápagos tortoises in his office, space always being at a premium. Few doubt that it was Blackie who held the tatters of the National Zoo together in its early years.

And it was a tatterdemalion affair to be sure. For several years, after near extinction in 1892, there were no funds for the acquisition of animals. A total reliance on donations led to some peculiar situations. Superintendent Baker cut a deal with the Adam Forepaugh Circus: they could overwinter their animals on the zoo grounds and the keepers would feed them—in return for any live births. It was a good enough deal except that after two overwinterings there were no live births. The deal was canceled.

To help create a numerically respectable "inventory," the zoo sent fliers to kennel clubs, asking for donations. In due course, by 1896, there was a dog exhibit, which soon had to be moved to the center of the zoo after neighbors complained about the barking. Among the donations were a sheepdog that died of old age within a month of arrival and a terrier that was blind in one eye. A biter, it eventually had to be shot. Later, Admiral Peary asked the zoo to temporarily house his sled dogs. The dog exhibit lasted into the 1920s.

There were, to be sure, what we think of as "zoo" animals in Rock Creek. Elephants, donated by a circus, caused a sensation in downtown Washington when they were taken to the new zoo grounds on April 30, 1891. For years, they would be led daily to the waters of Rock Creek to bathe and cavort. The zoo traded guinea pigs that had been bred over a three-year period to an animal dealer for a kangaroo. Alexander Graham Bell donated some mandarin ducks. A circular in 1900 to members of the Foreign Service listed desired animals and resulted in many donations, including the first Tasmanian wolf in the United States. President Grover Cleveland, who had inaugurated the

Tasmanian wolves, actually marsupials, lived at the zoo in the early 1900s; they are now believed extinct.

Zoo superintendent William Mann collected animals with his wife, Lucy, in British Guiana in 1931.

tradition of giving to the zoo animal gifts that had been bestowed on the nation, contributed a golden eagle. This set a precedent for the National Zoo's selection years later as recipient of Ling-Ling and Hsing-Hsing, the hotly contested giant pandas from China.

In the early years, more animals died than were born annually—par for the course in zoos at the time. Tropical creatures like flamingos died in cold winters; Arctic animals faded away in Washington's hot, humid summers. Animals that could be fit into the zoo's single building were arranged side by side, with prey animals next to predators. "Timid animals suffer greatly when put in a house with large carnivorous beasts," noted Superintendent Baker. Captive breeding of native endangered species—Hornaday's original dream—went by the board as the zoo sought donated animals to please local crowds, by way of proving its worth in the eyes of a tightwad Congress and a financially strapped District of Columbia. And it was a highly popular attraction. People flocked to the zoo, even though it was hard to reach and its officials still hadn't figured out where the main entrance was, a squabble that wasn't resolved until the 1920s.

In 1925, a renowned entomologist, William Mann, became the third superintendent. A man of flair and impeccable scientific credentials, he had been in the habit of donating animals to the zoo. One of his first acts as director was to persuade auto magnate Walter Chrysler to pony up $50,000 for a collecting expedition to East Africa. After a six-month trip, Mann brought back more than a thousand creatures, including a purple-faced monkey, elephant shrews,

two giraffes and the largest leopard ever captured.

Mann wanted rarities, firsts. In 1928 he talked an animal trapper out of selling a baby gorilla to a wealthy woman in Cuba who had the habit of surrounding herself with primates—giving them, it is said, the run of the house. Instead N'Gi became the National Zoo's first gorilla, inspiring huge lines. N'Gi was the most popular animal to live in Rock Creek Park until Ling-Ling and Hsing-Hsing arrived almost a half-century later. In N'Gi's first ten days there, 100,000 people streamed past his cage. Other Mann firsts for U.S. zoos were the aardwolf, the dwarf armadillo, the Rhodesian baboon and the blue bear.

Mann resorted to unusual practices to acquire funding for the zoo. A conference held at the Smithsonian in 1926 was attended by the U.S. Director of the Budget. A small zoo exhibit had been set up for this occasion. The budget director passed a mynah, which inquired, "How about the appropriation?" He replied, "That's impertinent!" And the bird said, "So's your old man." Director Mann innocently promised to find out how the bird had learned such talk and the zoo got an extra $40,000 that year. Later, an animal dealer offered Mann $350 for this $40,000 mynah and was turned down.

Still there was typically no money for housing and tending animals. Asked where some new acquisition was to be put, Mann would reply airily, "Blackie will find a place." And, especially when he was helped along by an unexpected source during the Depression, Blackie usually did. For with the Depression came the Public Works Administration and, in one year, an unheard-of sum exceeding $800,000 was appropriated for the zoo. The result of this and subsequent largess was a new wing for the Bird House, and new elephant and small-mammal houses.

Of course, with the onset of war, the big money was promptly cut off. The last of Mann's collecting expeditions returned in 1940, shadowed by German U-boats. But the zoo had become quite a different place from what its shaky beginnings might have forecast. Immensely popular with resident and tourist alike, it was also an inspiration to many a young naturalist. E. O. Wilson, the dean of sociobiology and a renowned student of the life in tropical rain forests, said several years ago, "When I was a 9-year-old living in Washington, D.C. and was just becoming aware of the world of science, I thought the National Zoo was heaven and its director, William Mann, was God."

In 1955, Mann hired a new veterinarian, Theodore Reed, who arrived from Portland, Oregon; he would become director a little over a year after Mann's retirement. Upon arrival, Reed immediately had to face the

A typical 1920s promotional event featured a jazz concert for the bears and an Isadora Duncan-inspired dance performance. Such events brought in the public, helping in the overall effort to secure more funding.

A white tiger explores the water; tigers and lions—the biggest cats—live in open, moated enclosures.

Arusha, a female Nile hippopotamus, favors the pool in her enclosure; she spends most of her day there.

zoo's typical financial straits. Finding no budget for medications, Reed would buy them himself at a local drugstore, later wheedling reimbursement from the zoo. Once a newspaper called to set up a photograph of the new vet. There being no budget for that emblem of medical science—a lab coat—Reed ran across the street and borrowed a white jacket from a barber.

At about this time, some local citizens got involved, founding a volunteer organization, Friends of the National Zoo. Today FONZ bumper stickers would appear to be the perennial favorite on local automobiles, and the organization actively promotes the interests of the zoo in the area, supplying valuable funds as well from its membership dues and management of the food, gift and other concessions at the zoo.

Under Reed's administration, the National Zoo continued to be immensely popular, attracting three million visitors annually. In response to rapidly changing times, he steered the zoo strongly in three new, related directions: education, conservation and research, the latter two activities going on largely behind the scenes.

It was clear by the 1960s that zoos were becoming net producers of exotic animals rather than consumers. The glory days of grand collecting expeditions were long gone. Nor could the point of a zoo any longer be the display of one or two individuals of as many species as possible: they would have to allocate more space to breeding populations. There were financial considerations as well (there are always financial considerations):

Gift of People's Republic of China, giant pandas Ling-Ling, Hsing-Hsing are zoo's biggest attraction.

the cost of obtaining most exotics was skyrocketing. More important, however, zoo people had come to recognize that animals from a species threatened with imminent extinction in the wild were priceless.

In 1964, S. Dillon Ripley, an ornithologist and strong conservationist, became Secretary of the Smithsonian. Two years later, zoo appropriation requests became part of the overall Smithsonian requests to Congress. More money flowed to the zoo and with Ripley's backing scientific research at the zoo took off.

It took several directions. The veterinary staff set out to make exotic-animal medicine a science rather than "witchcraft," as Ted Reed had called earlier zoo veterinary practices. For example, with the development of anesthetics deliverable by "flying needles" shot from a gun, it was now possible to immobilize large and dangerous animals to check on their condition, medicate them or perform surgery. But anesthetics are risky (whether you use too little or too much), so vets at the zoo began compiling experimental records of proper dosages and making them available to other zoos and wildlife-management organizations.

Shortly after Ripley's arrival, the zoo hired John Eisenberg, a leading student of animal behavior in the wild, and a staff of behaviorists, ecologists and reproductive biologists grew over the next 17 years. This new scientific research department conducted studies of animals both in captivity and in the wild—such as the elephants and monkeys of Sri Lanka, the tenrecoid insectivores of Madagascar, tigers and rhinos of Nepal. Among the animals studied in captivity were golden lion tamarins, small monkeys from South America. These studies showed that the tamarins—highly popular zoo animals—live in nature in extended families, with young ones helping to raise their own siblings. Without such training, the next generation would fail to raise their own young. Maintaining zoo exhibits of these animals in isolated pairs was henceforth out; extended family groups became the rule.

By the time the giant pandas arrived in 1972, causing regional pandamonium (75,000 people came to see them the first Sunday after they were put on display), there was a cadre of research biologists capable of mounting what is probably the most intensive study of a captive species ever. So far, however, although reams of reproductive data have accumulated, Ling-Ling and Hsing-Hsing have not produced successful offspring.

Because of its historic connection with the Smithsonian and its museums, the National Zoo has had a long tradition of keeping records—something often overlooked at many other zoos. Under Reed, record-keeping became a nearly fanatic preoccupation, tracking births, deaths, parentage, medical history and so forth. This effort contributed significantly to the revolution in zoodom in the 1980s. But meanwhile, the Smithsonian got wind of the fact that the Department of Agriculture wanted to dispose of a 3,000-acre tract of land about an hour and a half's drive west in Front Royal, Virginia. Thus in 1974 was born the zoo's Conservation and Research Center, fulfilling Hornaday's

Oryx—African antelope—are found with other exotic animals at the zoo's Conservation and Research Center.

Director Michael Robinson, here with ball python, is overseeing creation of wetlands, other environments.

dream of an exotic-animal breeding farm where small herds of animals could roam in conditions where they would be more apt to breed.

Even today one can see long black skid marks on the road, made when motorists rounding a corner among the hills look up to find the likes of zebras and oryx grazing in the Blue Ridge Mountains. Arabian oryx are now a major focus of breeding efforts at the center, along with black-footed ferrets, as well as Guam rails and Micronesian kingfishers (with the hope of returning viable populations to the wild).

In 1979, the zoo dropped a bombshell. It was a technical article in the journal *Science*, written by three researchers at the zoo: Katherine Ralls, Kristin Brugger and Jonathan Ballou. It reported on their study of 16 species of ungulates at the zoo—deer, antelope, elephants, zebras and pygmy hippos. Thanks to the existence of the zoo's records, the researchers could correlate juvenile mortality with inbreeding over several generations. In 15 species, juvenile mortality was higher among inbred offspring than in noninbred offspring. A later study at the zoo with 44 mammal species found the same pattern.

The implications were immense. Few zoos had sufficient space to maintain populations of mammals big enough to avoid inbreeding. Zoos would have to give up their rivalries and cooperate in an intracontinental, if not international, dating game. All the animals of a given species in North American zoos would have to be considered—and managed—as a single population. No single individual, or founder, could be parent to too many animals in that population. Zoo animals would have to be shifted from zoo to zoo to maintain a salubrious genetic diversity in the entire population.

*Stepping up interzoo cooperation*

With the prodding of scientists at the National Zoo and elsewhere, the American Association of Zoological Parks and Aquariums announced Species Survival Programs (SSP), wherein species that were imperiled in the wild and breedable in captivity, and for which sufficient data were available to create a studbook, would be singled out for special interzoo management. To date, 50 species of animals are being managed under SSPs in North America, and similar programs are in progress in Britain, Europe and Australia.

One of the earliest species on an SSP was the golden lion tamarin. Recognized as endangered, these animals had already been the subject of international efforts to increase their population. At the National Zoo and elsewhere, the tamarins were bred up to a sizable and genetically diverse population. Negotiations were held with Brazilian officials to introduce the golden lion tamarins to the wild. A group of them was assembled at the National Zoo and given training that taught them survival techniques, such as how to search for food. Then, in 1984, in cooperation with Brazilian scientists, they were released into a reserve in one of the remaining tracts of coastal rain forest north of Rio de Janeiro. At the time, there were fewer than 400 of this species left, and there was concern that they might be dangerously inbred because of isolation. In 1985, more groups were released and others have followed. There has been mortality: about half of the newcomers have died. But many others have begun to breed with the wild population. This program of repatriating captive-bred primates to the wild continues today, and shows great promise.

Another result of the National Zoo studies was the insight that wild populations of animals endangered by human encroachment could easily become too small to avoid the dangers of inbreeding. "Wildlife reserves and zoos are becoming one and the same," observes Christen Wemmer, director of the zoo's Front Royal Center. Populations in both places have to be managed

much the same way, a crucial insight for wildlife managers and planners around the world.

Meanwhile the zoo has entered the high-tech, brave new world of biomedicine with a group of reproductive biologists and veterinarians learning the esoteric techniques of artificial insemination, embryo transfers and the freezing of germ plasma. This last development is leading to what is called the "frozen zoo," the maintenance of zoo populations in small vials in freezers until mankind regains its balance and there is again room for wildlife.

And so today, behind the scenes, in a brand-new $3 million hospital, in labs, in zoo paddocks, and fanned out in reserves and parks around the world, scientists of the National Zoo—an entity that almost died only three years after its creation—are now in the vanguard of a dramatic, many-pronged effort to preserve something of the cathedral of life. And the public face of the zoo is changing almost daily.

Michael Robinson is implementing his dream of turning the zoo into a BioPark, an education palace "with live animals as bait," a place where the interconnectedness of all life—plant and animal, including us—is made clear for all to see. Old trees and new have become labeled parts of the exhibition program. A butterfly garden has been planted. When the Elephant House reopens it will house not only the live animals, but also casts of fossil remains on loan from the Museum of Natural History. The Institution's art museums will be represented throughout.

A small segment of Amazon rain forest will soon rise across from Rock Creek near Lion-Tiger Hill, designed to show, among other things, the microworld of such places. Associated with it, Robinson plans an Earth-watch gallery with features such as daily satellite data on the state of the Earth's environment. Robinson's BioPark, he says, will be a "shop window on the entire world of Smithsonian science and learning."

Meanwhile, a Komodo dragon laid an egg in late March. It takes about eight months for one of these eggs to hatch. It's a long shot, but if the egg hatches, it will be the first Komodo dragon born outside of Indonesia. At the zoo, there is always something like that to keep your fingers crossed about.

Visitors to the National Zoo enjoy the new wetlands exhibit, home for 42 species of animals and containing 70 plants found in wetlands ecosystems; this and other new areas reflect the idea of the zoo as a BioPark.

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Social scientists Todd La Porte, Gene Rochlin and Karlene Roberts observe the balancing act in the Power Control Center at Pacific Gas and Electric.

Waving the traditional thumbs-up, a naval airman dashes for safety as he signals that the launch bar that attaches plane to catapult is ready.

*By John Pfeiffer*

# The secret of life at the limits: cogs become big wheels

*Researchers learn how complex organizations like aircraft carriers and electric utilities perform so well when everything has to go right*

*The plane could have been destroyed and men killed. Midnight aboard the nuclear carrier* Enterprise, *an F14 jet fighter coming in fast, tailhook extended to catch an arresting wire stretched across the flight deck. All eyes are on the pilot, a "nugget" on his first cruise. Men stationed in the tower above the flight deck and at TV monitors below watch the Tomcat's glide slope. At the last instant it becomes clear that he isn't going to make it, and a flashing red light tells him so. He zooms off into the darkness for a second try, this one successful.*

*Early morning at the Oakland Air Route Traffic Control Center, two controllers at a radar console in radio contact with 11 planes heading for San Francisco, 11 short green lines moving across the screen. A few minutes ago there were only 7 lines; now things are getting crowded—15, 18, 22 planes about 40 seconds apart in flying time. A third controller joins her colleagues and together, by a strategic mix of rerouting and holding patterns, they provide safe passage for 3,000 incoming passengers.*

*An alarm clangs at a Pacific Gas and Electric (PG&E) switching station. Lightning has struck a 500,000-volt line bringing hydroelectricity from the Canadian Rockies. Switches automatically channel the flow of electric power to another line, but the extra load threatens further trouble—a "burn down," overloaded cables heating up to the melting point and outages affecting tens of thousands of people. A flashing light tells the station operator that circuit breaker No. 232 has tripped; a voltmeter reads zero; a ten-ampere reading on a current indicator places the break about 25 miles away. Repairmen are en route within five minutes.*

The effort to stay in control of things becomes more difficult all the time. No one, no thing, has ever been perfect, but the price of error is higher than ever before. For hundreds of millennia in the prehistoric past, individuals defended their own land, built their own shelters. Settlements were far apart; accidents affected relatively few people.

Today, living close together in complex social networks, we may become victims of other people's mistakes—on the positive side, we owe our survival to reliable strangers. We depend more and more on a rare breed of specialists trained to hold the line against chaos. They make their share of mistakes. But they have developed ways of catching error early, preventing it from blossoming into catastrophe.

Our hour-to-hour security is in the hands of organizations driven close to, and too often beyond, human limits. All of them try to be perfect; none succeeds. But a few come extraordinarily close, and they are the focus of a major research project launched by three professors at the University of California, Berkeley: political scientists Todd La Porte and Gene Rochlin of the Institute of Governmental Studies, ex-marine pilot and ex-physicist respectively, and Karlene Roberts, industrial psychologist at the university's expanding School of Business Administration. They are chiefly concerned with the engineering approach that concentrates on the technology and ignores the human factor.

They have selected aircraft carrier flight operations, air traffic control and the PG&E power grid as prime examples of high-reliability, complex organizations

*Photographs by Dan Lamont*

Just before launch, crewmen check for fuel leaks, make sure control surfaces respond to the pilot's actions and inspect everything in sight. Here, three men signal that what they have looked at appears normal; two others wait for their part of the plane to be tested.

Crewman flashes the gross weight of an F14, including fuel reported by pilot, to the catapult officer in a "bubble" raised just a foot from flight deck. Steam pressure must be set by weight and wind conditions for each launch. Information is given visually to avoid ambiguity.

which, in the throes of adapting to fast-changing times, manage to achieve remarkably low failure rates. They have come upon a new kind of organization, new in the sense of a species that has been occupying its niche for a long time, but has only recently been identified.

Most organizations consist of people in separate categories: big wheels, cogs, and specialists like accountants or chemical engineers. But the high-reliability version is a hybrid, a mix of these roles played by the same individuals under different circumstances. The big wheels are there, but use their power rarely. The chain of command is much in evidence, orders may be barked out, and subordinates behave appropriately as spit-and-polish yes-men. But when tension is running high, all work together as specialists among specialists on an equal footing in a more collegial atmosphere.

The most striking and surprising role change occurs in the white heat of danger, when the entire system threatens to collapse. Then cogs can become big wheels. Whatever their status in the formal hierarchy, they are trained intensively every day so that—based on their expertise—they can take complete command, redirect operations or bring them to an abrupt halt. The system works. It comes under greatest strain when top executives remote from frontline action issue unrealistic orders to people down the line. The Berkeley investigators note that even in the most effective organizations there tends to be a chronic gap between "taskers," who give orders, and "operators," who must carry them out.

One crewman dashes clear while another completes his check of hydraulic lines that operate the landing gear. Teamwork has to be perfect: during a mission a plane is rolled into position, checked from nose to tail and launched, every 50 seconds.

Black-visored pilot of an A-7 Corsair waits for the final hand signals that will tell him he is about to be fired into the air. The button will be pushed by a catapult officer he does not see. The last member of the launch crew has begun his run to safety.

Nobody has ever looked at high-reliability organizations the way La Porte, Roberts and Rochlin are looking. I invited myself along to see how they do it, as well as what they are finding out. All three are living for extended periods in the thick of things, observing operators who deal with emergency on a routine basis and somehow manage to remain reasonably sane. They came primarily to watch, listen and learn. Now that they're beginning to understand what is going on, they've gone a step further, from observation to criticism, offered gently but firmly. For one thing, individuals at the top in today's organizations have more to learn and less time to learn it; the higher they rise, the truer this becomes. This problem is as old as the Stone Age, but the price today is astronomically greater.

Such interdependence is new for our genus. After five million years of relatively little change, the first traces of formal organization appeared 35,000 years ago during the Upper Paleolithic (SMITHSONIAN, October 1986), as part of the effort to build stable societies out of fallible individuals.

The effort persists. Population continues to rise, along with the frequency and cost of error. There are lessons to be learned from highly reliable systems. When working on the razor's edge of catastrophe, success demands constant training and easy communications from bottom up as well as top down—and that, in turn, demands leaders who are prepared to listen to and learn from their subordinates (easier said than done). These are among the principles that can help us

avoid future Bhopals, Chernobyls, Challengers—or mistaken attacks on Iranian aircraft.

Consider the work on aircraft carriers. Project High Reliability began in 1984 when Capt. Thomas Mercer, commanding officer of the USS *Carl Vinson*, a nuclear carrier, encouraged the three researchers to come aboard. Now a rear admiral and head of Battle Group Bravo (the USS *Nimitz* and nine accompanying warships), he recalls his feelings about the study: "I approved it mainly for good public relations, more for them than for us, half hoping but not really expecting that the Navy might learn something. I'm amazed that they find us so interesting." The professors spent 150 days aboard several carriers. I made my first and only carrier landing to join them on the *Vinson*.

Early morning mission in 400-fathom, choppy seas off San Diego. Rochlin taking notes in a gray steel cubicle directly below the *Vinson* flight deck, dark except for subdued lighting on a control console. F14 Tomcat No. 104 is approaching, seven seconds away from a "controlled crash" landing, seven seconds of incredibly condensed action. This is the time of maximum stress for the ship's company as well as the pilot. (Pilot heart rates are significantly higher during carrier landings than they are in combat.)

A man at the console calls "F14 Tomcat one-zero-four, five-four-zero" and pushes the F14 button. The "540" informs him that the plane is coming in at a specified weight, 54,000 pounds, and that determines the tension of the arresting wires. The figure is crucial. A wire too taut for the plane's slamming hook-on may snap, lashing across the deck at leg-severing level; too much slack could send plane and pilot skidding off into the ocean. Nearby in the arresting-gear room, four men hear the numbers, crank a dial to 540, and call "Gear set! Gear set!"

"F14 Tomcat one-zero-four, five-four-zero." The same message sounds at the same time above the flight deck in the aircraft handler's office at the foot of the tower, where La Porte is keeping tabs on a game played for real. The room houses a "Ouija board," a model of the six-acre deck scaled down to desktop dimensions. Every one of the 20-odd planes lined up outside is represented by a scaled-down plastic piece and one of them, the F14 No. 104 piece, is about to be placed in position when it lands and is moved off the miniature runway.

"F14 Tomcat one-zero-four, five-four-zero." Again, the same message, only uttered from on high in a different pitch—a woman's voice, the only woman among 5,800 men. Psychologist Roberts is standing

*John Pfeiffer, best known for his writings on early hominids, is currently at work on a book on what social scientists are discovering about today's version.*

In Flight Deck Control, Comdr. Richard Moore and assistant keep models current on "Ouija board."

Officer outside on the flight deck peers into bubble where the button is pushed to launch 30-ton aircraft.

The sound-powered phone on the sailor's chest will continue to work even if power should be lost.

Catapult officer Lt. Mike (PeeWee) Blanchet makes sure that the flight deck is clear before a launch.

seven stories above the flight deck in the ship's control tower, home of the air boss. "Scared spitless" but not showing it, she is playing the role of spotter-in-training, identifying each plane as it approaches, under the watchful eye of an experienced spotter.

The talking never stops. An excerpt from La Porte's field notes: "They talk to reduce ambiguity of information, to correct misinformation, often without a hint of blame or accusation." A network buzzing with signals repeated over and over again. It includes pilots in midair, Mercer high on the bridge, men at green-glowing radar scopes three decks below the flight deck in the library silence of the Carrier Air Traffic Control Center, monitoring the ship's airspace. The air boss is in touch with all of them over a score of channels, radios, sound-powered phones, TV monitors, squawk boxes and a public address system powerful enough to out-decibel the racket on the flight deck. He has the last word: "Clear deck!"

*For 21 planes safely down, a "Nice going"*

The professors will compare notes later, but not now. It's a "hot spin" for F14 No. 104, being refueled for an immediate catapult launching with a new pilot. The arresting wire is sliding back into position, set for a new tension—all in a matter of seconds because attack bomber A6 Intruder No. 502 is descending fast at 36,000 pounds. And on and on, 21 planes in all, each requiring a different wire setting, landed without mishap at 50-second intervals. Air boss to spotter Roberts: "Nice going."

Now 150 officers and enlisted men are moving shoulder to shoulder across the full width of the flight deck, heads down. It's an FOD (Foreign Object Damage) walkdown. They're picking up every bit of debris that could be sucked up into jet engines and damage spinning turbine blades—scraps of wire, metal filings, nuts and screws—clearing the deck for the next mission already under way. Rochlin notes the competition to spot debris and the lack of deference to hierarchy—the latter, he says, a signature of high-reliability organizations.

The beat goes on. Peacetime carrier duty is primarily training—100 to 150 missions every day during six-month deployments at sea, some 20,000 launches and recoveries.

The research challenge is to understand precisely how it's accomplished. Carriers seem to be run directly contrary to common sense. You'd expect that complex organizations engaged in hazardous activities would require experienced individuals, the more the better, and especially among the top brass. Yet the captain will be aboard for only three years, his 20 senior officers for about two and a half; most of the more than 5,000

enlisted men will leave the Navy or be transferred after their three-year carrier stints. Furthermore, the enlisted men are predominantly teenagers, so that the average age aboard a carrier comes to a callow 20.

The job of providing continuity falls to middle and lower management, a cadre of about 300 petty officers with long carrier service. According to La Porte, "Their collective experience is the ship's memory; they run the show." They do much of the training and conduct the frequent drills, always emphasizing "redundancy" —nonstop repeating of messages.

Carriers also use another kind of redundancy. Microchips are reliable enough for many purposes, but when lives are on the line, that isn't good enough. For every radar or computer, a carrier has at least one backup machine—and that still isn't good enough. In combat, power may be lost. So information about landings and launchings is written with grease pencils on status boards in the air boss' tower perch, the aircraft handler's office where the Ouija board is and the combat direction center.

What Mercer and his fellow officers work hard to maintain is a quality rarely encountered in the civilian world—completely unselfish devotion to the task at hand. A feeling for the team, the ship, the Navy, a feeling so intense that when someone else slips up, you feel as depressed as if it were your own failure. "This is the sort of thing that usually happens only in a family," Rochlin notes. "It's very impressive to see it working; the kids take it very seriously."

Parties serve to cement solidarity; "cake cuttings" commemorate birthdays, holidays, jobs well done, practically any air-squadron anniversary. Carrier cooks had better be good bakers. Several years ago Vice Adm. John Fetterman issued a memorable "Cakes Forever" message. Someone in Washington had come up with a new rule: cakes were no longer to be baked in carrier kitchens, but purchased from commercial bakers, to be loaded aboard at intervals by naval supply ships. Fetterman would have none of it: "The cake at sea is a very important symbol. It's a way of honoring our men. You want it baked at home, inside the ship." That rule died fast.

Look back for a moment to November 2, 1985, time 5:45 P.M. The *Enterprise* is at sea, being evaluated for operational readiness. Bishop Rock, a shoal off the coast of Southern California, lies dead ahead. A number of men on the bridge see the shoal's big red light and assume their captain does, too. He doesn't. The result: millions of dollars in damage.

Roberts' report, to appear in the Naval Institute *Proceedings*, identifies this incredible accident as a classic case of "driving the bridge," projecting such authority that subordinates tend to keep their mouths shut. She reemphasizes a "not very startling" lesson: create an open, give-and-take atmosphere which encourages your men to speak up. Most captains do just that; the ones who don't rarely become admirals. Beyond that, Roberts suggests extending the psychodrama approach to training in which all officers and enlisted men would act out various roles in driving-the-bridge scenarios, and perhaps learn to behave more effectively in real-life situations.

La Porte voiced some of his most pointed suggestions during the last few days of his last carrier cruise. The *Enterprise* had just completed a four-day, nonstop, 600-mission exercise near the "Bear Box," a region north of Guam within range of Soviet reconnaissance planes from Vladivostok. In the midst of the exercise the fleet admiral had subjected carrier flight handlers to an extra strain: a sudden change of plans that disrupted tight schedules. Imagine trying to re-

Carrier duty means nonstop communication. Rear Adm. Tom Mercer, left, directs action from the tower.

Commander Moore, next, keeps order on flight deck. Capt. Tom Morgan, center, takes call in admiral's mess.

arrange cars in a crowded parking lot at top speed, with traffic jammed up and horns honking. The operators had to handle something far more difficult and dangerous, organizing on short notice a 15-plane anti-submarine mission, without delaying other missions. They made it, with some pride in their achievement.

But the aftermath was deep resentment at what they'd been put through, unrealistic and unnecessary risk to life and limb—a clear-cut case of overload, taskers having insufficient knowledge about the problems of operators. In complex organizations taskers are almost necessarily less proficient at tasking than operators are at operating. La Porte pinpoints the lack of, and the need for, an officially sanctioned way of "telling the Fleet they had fouled up," perhaps a board that would meet automatically after major exercises and give operators a chance to air grievances. As it is, carrier operators know that if they'd failed, a full-fledged investigation would have followed fast.

Do similar situations confront other organizations trying to minimize error? Peak intensities are part of the daily grind for Federal Aviation Administration controllers, operating the world's safest traffic-control system—15 billion flight hours in 1988, controllers "handling" planes 75 million times as they pass across radar screens, some 760 near-collisions (including one involving former President Reagan) and no collisions between radar-monitored craft for the past decade. It's 11 A.M. at the Oakland Air Route Traffic Control Center, which is responsible for air safety over some 120,000 square miles of the Far West, from the Pacific coast to halfway across Nevada and from the Oregon border to just north of Los Angeles.

You're sitting back in a Boeing 747 airliner en route from New York, altitude 35,000 feet, about 40 minutes and 275 miles from San Francisco. La Porte, graduate student Paula Consolini and I see your plane appear as a green line at the edge of Sector 33, on a radar scope monitoring air traffic at the Oakland Center. We have earphones and hear what the controller is hearing:

*Pilot:* "Oakland Center, United one-two-three, flight level three-five-zero [35,000 feet]."

*Controller:* "United one-two-three, Oakland Center, roger. Flight level three-five-zero cleared to San Francisco via Modesto 4 arrival [an air lane over the outlying city], maintain flight level three-five-zero."

*Pilot:* "United one-two-three, roger."

Another plane appears on the radar, another message to another pilot: "American fourteen-twenty, Oakland Center, reduce speed to two-five-zero knots."

This is superstress time. Now 22 planes are showing on the radar, and they must be kept separate from one another by at least five miles horizontally and 1,000 feet vertically. They move across the screen in 12 minutes (representing a ground speed of 500 miles per hour). Planes keep coming for another hour or so. Then time out for a breather, coffee and doughnuts, and "controller cookies" (antacid tablets) before the next onslaught.

The pressure comes in prime-time bursts, 55-60 or more planes an hour. This is a compromise load, somewhere between 100 percent safety and an unacceptable failure rate. You'd probably have perfection at 20 planes an hour, and the onset of accidents at 70-plus planes. Ralph Marsh, veteran controller-supervisor, puts it this way: "The cost of doing business is an occasional error and near-collisions resulting in a loss of separation. It's pure economics, the result of half a dozen major airlines competing on the most lucrative routes at the most popular flying times."

Traffic volume is increasing at a prodigious 10 percent annually. No letup, no end in sight for this pro-

Capt. James (Slick) Harnett, next, is an air boss; he nears the end of 35 hours on duty in control tower.

On phones at right is Comdr. Will Pear, an assistant, who has since been promoted to air boss himself.

Crew members walk the length of the flight deck, picking up everything that could damage a jet engine. The social scientists find it very significant that this chore is done with absolutely no regard for rank.

cess. Call it evolution on a rocket course. And what about the people? More than 14,000 controllers, more and more of them women (15-20 percent, according to recent estimates), at least 2,000 more needed and authorized, but trouble finding individuals willing never to be rich—and a thankless job at that. Do we need more cake cuttings? Less driving of bridges? Continuing education up as well as down the hierarchy?

There's no end in sight for PG&E either. Operator of one of the nation's mammoth power grids, it includes 100 plants generating electricity by hydropower, fossil fuels, wind, geothermal steam, nuclear reactors—and 1,200 substations linked by 131,000 miles of lines, serving some four million customers. The rhythm here is only slightly more relaxed, a cricket-match situation where nothing seems to be happening most of the time, but when it happens it happens fast and you'd better be ready. La Porte, Roberts and I are at another hot spot, the Power Control Center at PG&E's San Francisco headquarters. The task here is to hold the flow of power steady in the teeth of expected daily and seasonal peak loads, unpredictable and sometimes inexplicable power surges—and outages due to ice and snowstorms, lightning bolts, equipment failure, errant birds and squirrels and people. (Drunks and poles collide two or three times on an average night, in all seasons.)

We're listening in on the dispatcher in charge, the "power broker." The magic number for him is 7,400. That's the number of megawatts the area requires right now, 8 o'clock in the morning, and he's keeping tabs on a screen to his right that flashes figures every four seconds indicating deviations above or below the 7,400 level: 13, 15, -12, 6, 39, -11, -19 . . . Anything more than 100, plus or minus, is unacceptable.

Looming before the power broker, like a panoramic movie screen, is a display board where the styluses of several dozen moving-paper charts scratch thin red lines recording the power outputs at as many stations. He is talking to Location 6, a generator 200 miles to the north: "What do you have at 6?" The answer, "21.3," indicates the present power level, and his "Why don't you give me 23.1?" calls for a corresponding increase. The power broker works a 12-hour shift, keeping track of 26 power sources simultaneously.

PG&E's per-customer record for the Golden Gate

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region: no more than 100 outage minutes a year. With 70,000 new customers annually, maintaining or bettering that record is getting more and more difficult. Complicating the task is unplanned competition. Hundreds of small companies now generate electricity by burning their wastes—and PG&E is required by law to buy from them.

The Berkeley investigators are settling in for the long haul. Even at this stage, however, certain things are clear. Life is not going to get less stressful, and a new kind of organization is taking shape in the interest of survival. It will continue to require some kind of formal hierarchy, but not rigid and not under all circumstances, and probably not most of the time.

The dangers of strict chain of command are all too familiar to Clayton Foushee, a social psychologist studying airplane-crew behavior. The FAA's chief scientist for human factors, Foushee cites an example of what can go wrong—the 1982 crash of a Boeing 737 that took off during a Washington, D.C. snowstorm, failed to climb fast enough and slammed into a Potomac River bridge, killing 78 persons. The cockpit voice recorder revealed a copilot who mentioned possible trouble several times (false readings on an engine-thrust gauge due to icy conditions), but low-key and not forcefully enough to influence the pilot.

We'll never know what this pilot was thinking, but the case fits a well-known pattern. At least two out of every three plane accidents are the result of human error, so the natural tendency is to select as pilots individuals not only highly skilled technically, gifted with fast reflexes and in top physical shape—but also ranking among the highest in self-sufficiency, daring and bravery. This is plain common sense, like the notion that in periods of peak emergency, strict chain-of-command systems work best. Common sense happens to be dead wrong.

The white-scarf-and-goggles image is a hangover from World War I days, and it may still apply to men flying single-seat, supersonic jet fighters. But Foushee believes that performance as a member of a group is more important in most cases: "The 'right stuff' is the wrong stuff now that aeronautical engineers have done a remarkable job of solving the reliability problem as far as machines and materials are concerned. But they haven't solved the human problem. We need team players more than stars." Alerted to the problem, airlines are beginning to require frequent teamwork training for their crews (SMITHSONIAN, June 1986).

We can expect there to be less waiting for accidents to happen. Investigations after the fact, in a crisis atmosphere, tend to go after individuals. The big problem, however, is generally the rules of the game, organizational policy. The Berkeley researchers have identified a number of universal features that seem to be essential for high reliability anywhere. Intensive training, simulating hazardous operations over and over again, would almost certainly have averted the 1984 Bhopal nightmare. Roberts points to the importance of open communication channels up and down the hierarchy: "A failure of free information flow from lowest to highest levels as well as the other way around can cause serious trouble—for example, the Challenger disaster."

There is much more to be learned. The least understood of all high-reliability universals is how to instill loyalty to the group, an ethic of dedication—just the opposite of the corporate rat race, me-against-you infighting on the fast track. Ceremony has a lot to do with it, and solid recognition—beyond cash prizes for suggestions and the awarding of gold watches at the ends of careers.

Human evolution is off on a new tack. People are coming closer together, not only jammed into buses and subways, but also crowded in a psychological sense, almost to the point of constituting a single organism. The mark of the times is the network, a declaration of interdependence, like a spiderweb: disturb it anywhere and it vibrates all over. Engineers call this "tight coupling." Our increasingly complex organizations find themselves in a no-choice situation. The pressure of events makes change inevitable, which means taking chances and inevitably making some errors. Error is not necessarily negative. It is a sign that we are indeed acting, learning, adapting. Shakespeare's Hotspur, a man of action if there ever was one, knew the costs and the benefits: "I tell you, my lord fool, out of this nettle, danger, we pluck this flower, safety."

Chief Petty Officer Wayne Post says he is getting too old for the pressure; he'll retire to the Philippines.

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*By Israel Shenker*

# A celebrated Roman vase has become a 20th-century phoenix

*Once thought smashed beyond hope, Portland's mystic urn has just received its third, and best, restoration by British Museum specialists*

Before latest restoration, glue from 1949 repair showed as gray lines. Figures may be mythical or historical.

When the British Museum announced plans to break up the Portland Vase, it sounded as though the vandals were at the gates.

That vase is one of the supreme artifacts of ancient times, wondrously fashioned, enticingly mysterious, vastly celebrated. Constructed of glass (but once thought to be of stone), it stands 9¾ inches high, with a maximum diameter of 7 inches. Although appearing black, it is actually dark cobalt blue with a relief of opaque milky-white glass. It was probably made about 25 B.C., perhaps in Rome by craftsmen adept in fashioning cameo glass.

A gifted artisan may first have dipped a partially blown globe of the blue glass into a crucible containing the molten white mass, or he may have formed a "bowl" of white glass and while it was still malleable, blown the blue vase into it. When the layers contracted in cooling, the coefficients of contraction had to be compatible, otherwise the parts would separate or crack. Then, working from a drawing, or a wax or plaster model, a cameo cutter probably incised outlines on the white glass, removed the material around the outlines, and modeled details of figures and objects. He most likely used a variety of tools—cutting wheels, chisels, gravers, polishing wheels, polishing stones.

Ultraviolet image of vase revealed break lines, missing areas (dark), enabled restorer to draw working plan.

Kenneth Painter, who recently retired from the British Museum, and David Whitehouse of the Corning Museum of Glass believe the carver was Dioskourides, a gem cutter who served Julius Caesar and Augustus. "The vase was found in a tumulus on the outskirts of Rome, inside an enormous sarcophagus," says Painter, "and there's reason to think it was from the burial of a member of the imperial family in the third century A.D."

At the beginning of the 17th century it turned up in the possession of a Roman cardinal. After changing hands, it was eventually sold to Sir William Hamilton, Britain's envoy to the Court of Naples. Sir William was an old hand at collecting, his eye for beauty well attested: wife Emma gained notoriety as the mistress of Lord Nelson, hero of Trafalgar.

When the Dowager Duchess of Portland saw the vase, she determined to have it for her home museum of curiosities. Horace Walpole described the duchess as a "simple woman, but perfectly sober, and intoxicated only by *empty* vases." For 1,800 guineas Hamilton sold her one more empty and three or four minor treasures, and they joined the olla podrida of the Portland Museum. Following her death in 1785, her collection was

Solvents in desiccator permeated paper wraps, relaxed glue; flexible circular clamps prevented collapse.

Next, fragments were taken from interior support and numbered; they were then placed on a plan.

sold at auction. On the 38th and final day a representative of the duchess' son, the third Duke of Portland, bought the vase for 980 guineas.

The identity and meaning of the figures on the vase have presented an enigma. More than 40 theories have tied them variously to stories concerning Alexander the Great, or second-century physician Galen, or mythical lovers, the underworld, birth, death or immortality. Painter and Whitehouse believe the vase commemorates the legendary destruction of Troy and the achievements of the golden age of Augustus.

A glass disk attached at the bottom did not really form a part of the vase—it was another color, another style—and was removed in 1949. An 18th-century cast shows that the vase had been fractured, possibly when an accident separated its original base. Perhaps to avoid further vicissitudes, the fourth Duke of Portland in 1810 loaned the vase to the British Museum.

On February 7, 1845, a young visitor picked up a handy weapon—described as a "curiosity in sculpture" and a "Persepolitan monument of basalt"—and smashed the glass case and the Portland Vase inside. He gave his name as William Lloyd, his address as a coffeehouse. After examination by experts described in the *Times* of February 12 as "medical gentlemen," he maintained that he "had been indulging in intemperence. . . ."

Britain's Wilful Damage Act did not appear to cover damage to an object worth more than £5, but the prosecutor pointed out that Lloyd had also smashed a glass case worth £3. Sentenced to either pay £3 or spend two months at hard labor, Lloyd went to jail, as he had only ninepence. Two days later the magistrate received an anonymous letter: "I take the liberty of enclosing three pounds, as wich is the paultry penelty in default of paying wich you have sentenced my relation through Adam and Eve poor Mister William Lloyd the Irish gintelman to two months hard labour."

With the vase in about 200 pieces, the museum's John Doubleday set about gluing it together, and by September the treasure was back on show. In 1945, the British Museum bought it from the Portland family for £5,000. Three years later, a small box from the executor of the late G. H. Gabb arrived at the museum. Inside were 37 tiny chips of glass. A letter explained that Doubleday had not managed to include these and had put them in a drawer; after Doubleday's death another vase repairer gave them to Gabb, commissioning him to make a box for them. Before Gabb finished the box, the vase repairer died, and Gabb evidently forgot to forward box and chips before *he* died.

With this unexpected gift of Gabb, the museum decided to dismantle the vase and try to fit in the missing pieces. The greater motive was to remove old, discolored glue and replace it with a colorless modern variety. Conservator J.H.W. Axtell took on the job in 1949 and managed to include three of the 37 chips.

Last year, with glue again discolored and brittle, it was decided once more—not a vandal in sight—to dis-

*A frequent contributor, Mr. Shenker has written about sculpture workshops at Pietrasanta, Stoke-on-Trent's potteries, Edgar Degas, Giacometti and Legoland Park.*

# *Mary Brodie won't feel the lump in her breast for another two years.*

Like a lot of women, Mary Brodie understands the importance of regular breast self-examination. And because she's never felt a lump, she thinks everything is fine. It's the same conclusion a lot of women reach.

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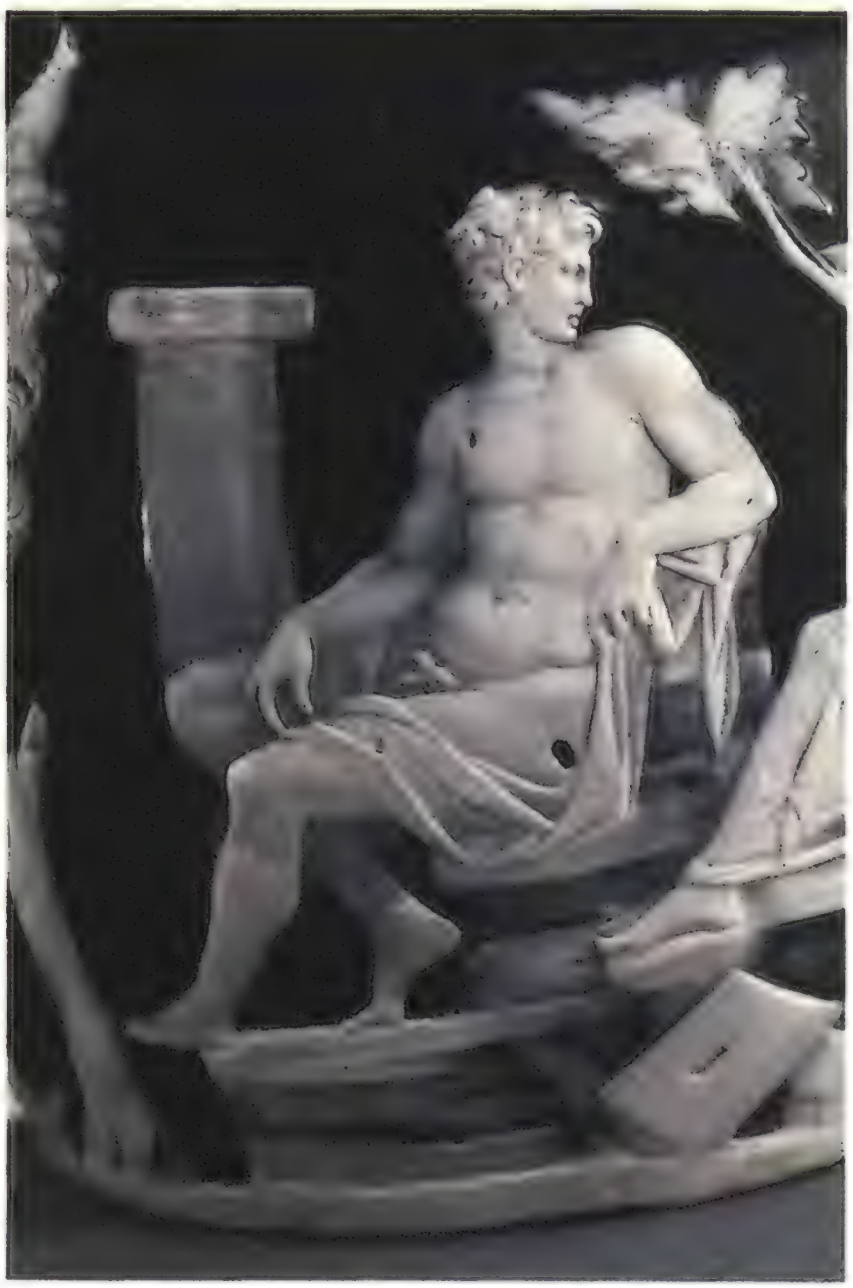
mantle and reconstruct. The task fell to 44-year-old Nigel Williams, chief conservator of ceramics and glass. On holidays, Williams always takes a 5,000-piece jigsaw puzzle with him. "What I like best is sticking things together, fitting fragments or sherds and coming up with a pot," he says. "To think nobody's seen that for two or three thousand years, and you've put it together again. After that, you look on the thing as yours." Even in the least stressful of times, Williams suffers from claustrophobia and insomnia, and the stresses of this assignment promised no relief. "There was loads of pressure," he tells me. "It's an important piece—a wonderful piece."

Studying the vase, he decided on a plan of action. First he lined the inside with overlapping strips of white blotting paper moistened with distilled water. The next morning he saw that the vase had seriously weakened. "I was very surprised because I thought the vase was stuck together with epoxy resin, and I wouldn't have expected water to have affected it as much as it did. But in fact the vase began to come apart. It had moved—there's no doubt about it. It was now much more fragile. I was worried, I was decidedly worried, because I hadn't got any strength on the outside, or the inside. The first thing to do was to get a layer of blotting paper on the outside. It began to hold the thing together again."

Then he painted a thin layer of plaster of paris onto the blotting paper on the inside. Plaster of paris expands slightly as it hardens, and the blotting paper absorbed the expansion, preserving the glass from damage. When the plaster had hardened, Williams and his assistants put flexible clamps at different heights around the glass. "I put methylated spirits in a container at the bottom of a desiccator and lowered the vase into the desiccator, on a platform just above the solvent container, and left it there for three days. On the last day I opened the top, put in a hypodermic and squeezed in methylene chloride, the solvent for epoxy resin. This is the dangerous point. One can't afford to

In prerestoration photograph, damage to column capital, right heel and leg of seated figure is apparent.



Nigel Williams repaired damaged areas with mixture of epoxy and glass "balloons," vastly minimized joins.

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Restorers check fragments on shoulder of vase for fit in order to insure the correct sequence of assembly.

let it collapse in an uncontrolled manner. All I wanted was the atmosphere; I didn't want the vase actually *in* methylene chloride—it's not a very nice material to use. Of course the blotting paper also absorbed this material and kept it in contact with the vase."

The next day, he opened up the desiccator and allowed the solvents to evaporate. "We noticed that one of the handles had moved dramatically and was only being held by the support clamp. So before we took out the vase we removed the clamp and took off that handle. It was the first piece to come off."

With his scalpel he then cut away the first layer of blotting paper around the top of the vase and peeled back the next portion. The solvent had worked; the pieces were free on their interior plaster-and-blotting-paper support. Gradually removing the exterior blotting paper and the clamps, he picked pieces of the glass off the backing, handing them to an assistant who numbered them on the inside with water-soluble paint. The fragments and their corresponding numbers were then placed on a plan drawn from the ultraviolet images of the vase. A second assistant kept watch over what was happening at the back. Williams could have used a mirror, but "A mirror doesn't have hands." If a piece fell out, he wanted somebody to catch it.

*Tension to excitement to elation*

"I was nervous," he says, "but my hands weren't shaking. I don't think I had anything to eat the night before. My stomach was a bit tense. I tried not to think of it as the sort of object that it is. That's potentially more dangerous than anything else. As the tension grew less, the excitement grew. I knew it was working just as I'd hoped—very controlled. I was moving from tension to excitement to elation when it was done. I had it there, sitting in pieces. Then I thought, 'My God, this is just Day One.' It actually took a complete day, about five hours. I didn't rush it, but I didn't want to be too long, because it was now out of the solvent. The solvent evaporates fast, and as it evaporates, the joins begin to reharden. The second handle had quite a lot of body attached to the top of it, and that was clamped between two fragments. I had to get the handle out to get to those two fragments—taking hold of the handle and wiggling it and putting a bit of pressure on it. And the thing came down beautifully. We didn't lose any pieces, and we didn't break any, either.

"We removed 154 pieces from the vase. Since then we've actually found about four or five other pieces—small chips—that we didn't notice were joins: when we took a big fragment out, it came away and took its little brother with it." Adding the 26 tiny fragments in the box (several of the smaller chips had been sent out for chemical analysis), the total was thus some 185.

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Re-creating portions of frieze is delicate work. As a guide, Williams depended on an 18th-century plaster cast, made before the vase was smashed. Using surgical scalpel, he turned sculptor to restore missing features.

With a surgical scalpel, Williams cut away most of the epoxy under a microscope; then, using a Q-tip dipped into a 50-50 mixture of acetone and methylated spirits, he cleaned the edges. The surface had fill—wax from the 1949 repair. "In many cases we were not looking at the vase, but at polished wax. That's again a process of cutting away; the wax is blue, so it's very difficult to see against blue. Where you do tend to see it is in the pores of the white. If there's any danger of damage to the glass then it's better to leave it." With soft soap and warm water, most of the wax decamped.

"It's enormously important in reassembling to start with the right piece. The most logical thing would be to use the biggest piece first, but it may not be the piece you use first. It's really the piece that tends to lock in with its mate. You have to get the curve right. Pieces 1 to 150 may be all right, 151 may be slightly out, and by the time you get to 180, it's way out. At best there are 600, perhaps 800 edges. You have to beware of trap-outs, where you fit two fragments together and the third won't fit in because of the shape you've made. Anyone can stick it together and make it look terrible. I have to stick it together and make it look good—and accurate." As Kenneth Painter, the curatorial adviser for the restoration, says, "Every fragment is a chance to go wrong."

Williams did the enormously difficult reconstruction of the museum's Anglo-Saxon iron helmet from the celebrated seventh-century Sutton Hoo ship burial, found in 1939 near Woodbridge in Suffolk. For three months the fragments lay on his workbench, defying his best efforts until he finally saw—as he put it—how *they* wanted to be united.

The Portland Vase was equally challenging. "I didn't actually start with a particular piece of the vase," Williams says. "In one area I had a lot of little fragments and decided to fit all those together to make one bigger fragment, and I made about ten big fragments. Then I joined those big fragments together. And that gave me my ring.

"Amazingly, the lower section—the part with all the figures on it—came round first time, in two days. Except I didn't actually complete the ring. I just put some Sellotape [the British counterpart of Scotch tape] across the last join, because I knew the really difficult part was the upper section. If I'd made that ring absolutely solid, it wouldn't have allowed me any flexibility in the lower half when I joined the top to it.

"My main adhesive was HXTAL NYL-1, an epoxy that has been tested for aging and virtually doesn't yellow," Williams says. "But it takes seven days to cure completely. So I painted HXTAL along the edge of a frag-

Mikhail Baryshnikov. Cardmember since 1975.

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ment and left a small gap. In that gap I put a tiny glob of Loctite 35038, which—under ultraviolet light—takes only 20 to 40 seconds to cure. If I wasn't happy with the join, I applied a very mild solvent to the Loctite, and within ten minutes it would come apart. I frequently had to do that three times. Both adhesives were much thinner than any that had been used previously, so all the fits were tighter.

"Formerly, while you were hunting for where a piece goes, you would be holding a sliver of glass with metal or plastic tweezers, and if you applied too much pressure you had three slivers. Luckily, we now have vacuum tweezers, and they allow us to hold the fragment without putting pressure on it. It's a question of patience and time. And we tend not to do it for more than a couple of hours a day. You come in first thing in the morning when your eyes are fresh and you may find two or three joins, and you find fewer as the day goes on. I learned a great deal about what previous restorers had done. They worked away the edges of fragments to make them fit.

"The upper part took me nearly three weeks and ruined my Christmas. It wasn't going right, and bits were not slotting in as well as I'd hoped they would. When I finally knew I'd got it right, I went home and slept 15 hours."

Williams and his assistants worked on the Gabb chips for three weeks—each doing a two-hour shift daily—and fitted 15. The remaining 11 stubbornly refused to resume their original positions. Under a magnifying glass all showed signs of turning, indicating they came from the inside of the vase. Williams decided it would be unjustified to spend more time on them.

He wanted a colored resin to fill in the missing areas and sought a cobalt blue and a violet—but, when subjected to light, the cobalt blue was unstable and the violet disappeared. The manufacturer of HXTAL, based in Austin, Texas, came to the rescue with special pigments from the Keystone Aniline Corporation—violet and phthalocyanine blue. Williams experimented to get the proportions right: three blue to one violet to three of the clear HXTAL resin. The components were scrambled together in a mixer for ten hours.

Williams plugged holes in the vase from the inside with dental wax. When he dripped the colored resin onto a plugged hole, it was too runny. So he added microballoons—tiny bubbles of glass finer than table salt. For most holes he applied this doctored resin with a paintbrush, and for larger holes dripped it from a spatula. He smoothed down these areas with Flexi-Grit, an extrafine aluminum-oxide sanding film, taking care not to rub the original glass. With a fine-bristle paintbrush, he applied a thin coat of the colored resin over the sanded portions, obliterating all trace of microballoons, then buffed the newly painted surface with polish normally used on car chrome.

He turned sculptor to restore three areas of carving. To guide his scalpel he had one of the 18th-century plaster casts; his white filler was clear HXTAL with microballoons added to make it opaque.

"This is a frontline exhibition piece," Williams suggests. "The public wants to see a complete vase. A good restoration allows a visitor to walk up to the object and have the whole visual look of it, and the closer you get the more obvious the repair becomes—and yet it has to be discreet enough so that it doesn't stare out at you. People come to see the vase; they don't come to see my restoration."

Williams estimates that his reconstruction should survive unimpaired for 150 to 200 years. Then it will be time to undo it all again and start from scratch.

Joins are barely visible in resplendent restoration. Williams considers this the vase's most beautiful side.

# It looks like we're

The Accord LX 4-Door Sedan, as seen by other car makers.

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# e being followed.

t seems as if we've developed quite a following. HONDA

Oppressors all—bewigged aristocrat, mitred prelate and whip-wielding officer—crush the manacled common man under their weight in a 1789 caricature lambasting the predatory excesses of France's privileged orders.

*By Robert Wernick*

# Radical and chic, a duke who courted revolt and doom

*Enticed by the diverting allure of revolution, Philippe d'Orléans soon found himself at the mercy of forces he helped to unleash*

The French Revolution, begun in patriotic euphoria only a year before, was starting to turn sour. There was a smell of blood in the air, and prudent aristocrats were beginning to slip out of the country. The young Marquise de Gontaut was thinking of joining them. But for the moment it seemed safe enough to go out for an evening at the home of an old family friend, the Duc d'Orléans. All was still comfortably traditional and orderly there, the old-fashioned courtesy, the flunkies in livery, the candles, the violins, the silken gowns and knee breeches.

But this time some unpleasantly discordant notes were struck. The Comtesse de Genlis was there, once the duke's mistress and now governess to his children, and she was shamelessly wearing a dress done in blue, white and red, the colors of the revolution and a deliberate affront to anyone loyal to the white emblematic of the monarchy. Worse was to come. The young lady was asked by the oldest of the Orléans boys, the Duc de Chartres, to join him in a quadrille. The orchestra struck up the tune of "Ça Ira," the bloodthirsty air that the mobs were singing in the streets of Paris. The young Marquise de Gontaut politely backed out and fled as fast as she decently could from what she had recognized too late as an abode of evil, an 18th-century temple of what the 20th-century journalist Tom Wolfe would label "radical chic."

*The ancient lure of self-destruction*

In the 1950s, the poet-historian Peter Vierick had elucidated this phenomenon—the tendency of some members of the privileged classes to espouse ideas and subsidize causes aimed at their own destruction—and traced "ritualized chic" as far back as Alcibiades in the Athens of the fifth century B.C. Fashionable radicalism came into vogue, too, in Paris and Versailles near the close of the 18th century, nowhere more flamboyantly than in the behavior and person of Louis-Philippe-Joseph, Duc d'Orléans, better known by the name he took during the revolution, Philippe Egalité.

This year the French are celebrating the 200th anniversary of their revolution. Already, scores of books have poured forth, treating virtually every principal actor on that broad, bloody scene. But the odds are that there will be little attention focused on Philippe d'Orléans. Perhaps that is because the taint of opportunism makes him an unattractive character, but unsavoriness, or evil, has not stopped biographers from flocking around Nero or Joseph Stalin. More likely, it is because Philippe remains so hard to grasp, an unusual combination of transparency and ambiguity.

Philippe, born in 1747, was the first prince of the blood, cousin to the king and one of the richest men in France. At the death of his father, Louis-Philippe "the Fat" (his best-known exploit in life had been to eat 27 partridges at a sitting), the son came into an enormous fortune, one so great that he was instantly able to pay off the 24 million *livres* of debt he had run up in his hot-blooded youth. He held vast tracts of land, a good deal of it ceded in special grants from the Crown.

As a young man fitted out in hussar's regalia, Philippe looked more the fop than the bold cavalryman.

He started out, then, as a staggeringly wealthy young man. He was a reckless spender, a more than reckless rider (woe to the pedestrians of Paris when he was on horseback or in his coach), a hard-drinking, roistering, lascivious young man. The police officer whose job it was to spy on his private life reported that he showered his lady friends with money but that he was quite rough with them, lacking completely in *délicatesse*. He was very conscious of his rights as the ranking nobleman of the kingdom, and he lost no opportunity to insist on them. At his wedding to the heiress Marie Adelaide de Bourbon-Penthièvre, one week before his 22d birth-

The king appears before the revolutionary tribunal; Philippe joined in the death vote in January 1793.

day, he took a flying leap over the train of her gown when he noticed that he had been placed on the wrong (i.e., lower-ranking) side of the altar. He demanded that his cousin the king appoint him Grand Admiral of France, and when he was refused he took it very hard. He did participate in one sea battle, off Ouessant in Brittany in 1778. The story put out by his enemy Queen Marie-Antoinette that he hid in the hold all through the fighting was quite untrue. In fact, he acquitted himself well in this indecisive contest, but after the battle his detractors slandered him as an incompetent. The next year, Marie-Antoinette succeeded, at least for a while, in banning him from the armed forces altogether.

The king appears to have had no great opinion of his merits, either. Once, when he banished Philippe to England for revolutionary activities, Philippe said disdainfully to his king, "I will learn how to think [*penser*] there." Louis XVI, not generally noted for his repartee, deliberately misunderstood him to say "*panser*" (to curry horses) and agreed it would be a very good idea.

Whether Philippe ever learned to think or not is a matter of debate. He certainly voiced many opinions. They were the fashionable Enlightenment opinions of the time—against the church, against the monarchy and the divine right of kings—in short, liberal, democratic, egalitarian opinions. As a nobleman espousing radical ideas, Philippe was not, of course, an isolated oddity. He was simply a somewhat frivolous version of more-principled compatriots. Many of his aristocratic peers, cultivated children of the Enlightenment all, yearned to create a new order for France—even if that meant abolishing centuries-old privileges. What they did not count on was paying for that aspiration with their lives.

Philippe, in any case, was not the kind of man who let his ideas get in the way of his private life. He went on living recklessly, as a nobleman should, and he gave up none of his aristocratic privileges. His cousin the king might take timid steps toward reform by abolishing, on the royal estates at least, the vexatious and vestigial medieval institution of *mainmorte*. The practice provided that if a peasant died childless he could not leave his property to anyone else—it reverted to his *seigneur*, or feudal lord. Philippe never got around to abolishing *mainmorte* on his own properties.

Naturally, his own immense holdings took a large staff to administer. The duke's payroll was necessarily enormous and included many names that would become famous in the days of the revolution. Although many of these people were presumably working to line their own pockets, they were the duke's agents. One of their duties was to spread the word that Philippe d'Orléans was the people's friend, a radical, and far different from his stick-in-the-mud cousin the king. It all entered into the ferment of ideas—including those brought back from Revolutionary America by the Marquis de Lafayette and the other idealistic young Frenchmen who had fought there—that was sapping the structure of the French monarchy.

Paying for these agents, as well as maintaining the lifestyle of a prince of the blood, eventually called for so much money that even Philippe had to look for ways to increase his income. One way was to turn real estate agent. He had inherited the huge Palais-Royal,

*Robert Wernick, who has recently contributed articles on subjects from Francisco Goya to nightmares, spends part of each year in post-revolutionary Paris.*

with its harmonious arcades surrounding magnificent gardens, just across the street from the Louvre. He let out the ground floor to be turned into shops and cafés. The arcades of the Palais-Royal soon became the center of fashionable social life in Paris. Here was where you came to buy fine art or meet young ladies of uncertain morals. Since the Paris police had no right to penetrate the domain of the Duc d'Orléans, it was also a place where shady deals could be negotiated, stolen goods liquidated and subversive ideas openly discussed and preached.

There is a school of historians—right-wing historians convinced that the whole of the French Revolution constitutes the great abomination of modern times—who maintain that the revolution was conceived and plotted under the arcades of the Palais-Royal.

Furthermore, they maintain, the scheming went on under the direct supervision of the Duc d'Orléans, who hoped to overturn his cousin and seize power for himself. (The shadowy contingents plotting revolt included Orléans' lean-and-hungry personal secretary and sometime ghostwriter, Pierre Choderlos de LaClos. He had entered Philippe's entourage after being drummed out of the army for publishing his scandalous novel of aristocratic decadence, *Les Liaisons dangereuses.*) To be sure, historians have no incontrovertible evidence to offer. But, they say, look at how he turns up, in the foreground or prominently on the sidelines, at almost every crucial moment as the country lurched toward the abyss.

Mainstream historians dismiss this as nonsense. For them, the revolution was the result of profound forces beyond the control of any single man, especially the flibbertigibbet Philippe d'Orléans.

Just what those profound forces were and how they operated is the subject of endless debate—more than ever this year, as France celebrates its most famous historical convulsion. But there is general agreement on why the revolution broke out in 1789 instead of some other year. The immediate cause was the colossal budget deficit, or what would have been so called if the ancien régime had had a budget. The 18th century was France's golden age, population was steadily increasing —half the population in 1789 was under 21 years old—prosperity was steadily spreading. French cultural prestige was at its zenith, despite the loss of New France to Britain in 1763. But the king couldn't pay his bills. The political and administrative system of France was hopelessly archaic.

Everyone agreed that it would be fairly simple to take care of the deficit by reforming the tax system. But any move to reform anything ran into a crazy quilt of ancient institutions and privileges, which could not or would not be budged.

To some extent, Louis XVI *did* recognize the need for change. And in fact, he appointed a succession of reformist ministers. He ended up dismissing them, though, when they really tried to effect solutions. In the end, the king only let things drift and went on

Astride a table in the courtyards of the Palais-Royal, Camille Desmoulins sounds the revolutionary call "To arms, to arms!" The lawyer-journalist, one of the young radicals in Philippe's entourage, incited the crowd that soon stormed the Bastille.

Bastille-bound crowd parades busts of two potential saviors—the finance minister Necker and Orléans.

Bent on seizing the cache of gunpowder stored there, crowd of Parisians takes Bastille on July 14.

borrowing money. The war that won American independence (and was financed substantially by France) brought sweet revenge for previous defeats by England, but it saddled the French treasury with massive debts. And runaway inflation exacerbated the need for cash. By the late 1780s the king's credit had run out.

He convened an Assembly of Notables in 1788 to look for a way out, but the Notables, with Philippe d'Orléans among them, refused to act under pressure from the Crown. The next year Louis had no choice but to summon the Estates General, a gathering of representatives of the three orders of the kingdom: nobles, clergy and commoners. The Estates had last met in 1614, when they had proved to be cumbersome and useless. But this time reformers hoped to be able to use the Estates to break the straitjacket of the old system. The hope lay in unleashing the power of the commons, or Third Estate.

What enraged the members of the Third Estate was simply being kept out of things. They constituted 97 percent of the French population, but wielded relatively little power. Peasants had no recourse when heavy taxes were imposed. And the increasingly well educated and vocal middle class chafed under a welter of restrictions: the high positions in church, state and army were open to aristocrats almost exclusively.

The French aristocracy of the 18th century produced an impressive number of very gifted men (among others, the Baron de Montesquieu, father of the American Constitution) and, all things considered, they weren't doing a bad job of running the country. Compared with Russia or Prussia or the kingdom of Naples, for instance, France was an efficient paradise.

But there were too many forbidden fruits in this paradise. Throughout the 18th century, affluent commoners had risen into the nobility, largely by purchasing "entry-level" aristocratic appointments. But the process was slow: it usually took three or four generations to accrue full-fledged status and privilege. And by the 1780s, even opportunities of this kind had diminished. The ever more prosperous middle classes were producing young people who felt they had little chance to display their talents as they deserved, young lawyers like Maximilien de Robespierre, young army officers who were classmates of the Corsican Napoleon Bonaparte. Philippe d'Orléans saw that he could be a spokesman for these discontented young people, and many eyes were turned to him as he presented himself for election to the Estates General.

The elections could not have come at a worse time for the monarchy. The cold wet summer of 1788, the most severe in human memory, had ruined the crops, driven prices sky-high and filled Paris with unemployed workers, hungry and increasingly desperate.

Here was a revolutionary mob in the making, and one day in late April 1789, it actually took to the streets when a false rumor was spread that a Monsieur Réveillon, who employed 350 workers making painted

The Duc d'Orléans, who was nowhere near the scene, was enjoying an evening of theater in the suburbs.

wallpaper, had proposed to cut wages. With the scarcity of bread and the price doubled since summer, this was putting match to powder. The police had to be called in to protect Réveillon's house from angry demonstrators, apparently none of whom were workers in his factory. (He was, in fact, a notably humane employer.)

The mob was surging through the Faubourg Saint Antoine, a working-class district on the eastern reaches of Paris, when up clattered the carriage of the Duc d'Orléans, who had been watching the races at the track in Vincennes. He leaped out of the carriage, emptied his purse into outstretched hands and reaped a harvest of enthusiastic cheers before driving on. A little later, it was the turn of his duchess' coach. For some reason never made clear, it did not go through the Faubourg Saint Antoine but turned into the Rue de Montreuil instead. The police had barricaded this street to protect the Réveillon house, but they dutifully opened a passage to let the great lady proceed. A howling mob pushed through in her wake, and in a few moments Réveillon was fleeing while his home was burned.

Armed with pikes and axes, a mob prepares to march on Versailles and force the king's removal to Paris.

Thus begun, the rioting went on all day and all night, and cost 300 lives, or about three times as many as were killed in the storming of the Bastille ten weeks later. For historians of the conspiratorial school, this was the first blood of the revolution, and it was shed, they contend, because the duchess' turn into the Rue de Montreuil had been carefully plotted.

The government was still strong enough to suppress the Réveillon rioters harshly, and there were no immediate consequences. The elections for the Estates General went off as scheduled, and Philippe, who had taken the precaution of running in several localities to guard against unpleasant surprises, was duly elected to sit as a representative of the nobles at Versailles.

The Estates opened formally in May 1789 and soon, as expected, ran into a deadlock on the question of voting. Should each Estate have one vote, in which case nobles and clergy could block any serious effort at reform, or should they vote by head, giving the 300 representatives of the commons as many votes as the two other orders combined? The king and the court, who had no intention of conceding to the request for equal representation, fully expected the deadlock to last indefinitely and perhaps lead to an eclipse of the Estates General for another couple of centuries or so.

But on June 24 the Duc d'Orléans and a small band of liberal nobles entered the hall where the Third Estate was sitting. It was a crucial step in the transfer of power to the Third Estate, which was now calling itself the National Assembly and was intent on writing a new Constitution for France.

No one was sure if the king would accept this defiance of his divine right to govern. He summoned troops to Paris and to Versailles, and it was widely believed that he intended to use them to disperse the Assembly and stamp out opposition. There were anxious discussions wherever the friends of Liberty gath-

ered, particularly at the Palais-Royal. On the evening of July 12, an impetuous young lawyer and journalist, Camille Desmoulins, jumped up on a table there and made an impassioned speech that ended with the call, "To arms!" He led a shouting crowd out into the streets, the crowd that 36 hours later went to look for gunpowder in the ancient, decrepit prison, the Bastille, and took it by storm. On the way there, they massed before Salon No. 7 in the Palais-Royal's rented galleries, where a German-born craftsman named Curtius maintained a popular and profitable wax museum. Curtius surrendered two busts, which the crowd carried like banners before them: Necker, the finance minister, who they believed could solve the budget problem, and Philippe d'Orléans. And so the duke's wax image anyway was present at the very moment when the revolution formally began. (Orléans himself was otherwise engaged, acting in a play produced by his own amateur theatrical company.)

In a few heady months the old order was thrown out, and a new one installed; feudal privileges were abolished, and Liberty and Equality were enthroned, at least as heady abstractions; and all without the shedding of a great deal of blood. Then early in October a Parisian mob suspicious of royalist plots, and indignant over rising prices and shortages of food, tramped out to Versailles. Bursting into the palace, the mob chased the queen, killed two royal bodyguards and forced the royal family to come back with them to Paris, to be under the watchful eye of "the people." And there, at this fateful moment, was Philippe d'Orléans, on the spot again "in a gray frock-coat," or so claimed an eyewitness. "The air resounded with cries of, 'Our father is with us. Long live King Orléans!' "

King Orléans—the word was out. That is to say, a liberal constitutional monarch who could provide a center around which a free people could rally. In 1789 it must have seemed like an ideal solution to many—a benign, respected ruler who could calm passions, reconcile factions and preside over an orderly transition to constitutional government. A George Washington, in short.

*Bungling his way to death*

There were only three men with sufficient background and prestige to conceivably play the Washington role in France. Louis XVI might have done it, and wishful thinkers assumed he would. But poor Louis was not cut out to take charge. Indecisive, tenderhearted, not very bright, the king bungled his way from crisis to crisis till he bungled his way to the guillotine.

A second candidate was the Marquis de Lafayette, an ambitious young man aureoled with immense prestige as the hero of the war of American independence. Lafayette was more than willing, but less than able, to run a government. As a politician he soon faded from the scene. In 1792, a revolutionary tribunal would revoke his command of troops led against Austria and recall him to Paris. Fearing for his life, Lafayette had to flee the country and lived out most of the revolution in an Austrian jail.

That left the Duc d'Orléans. It was a choice that in theory made perfect sense. He could appeal to all sides: as a prince of the blood, he represented the ancient traditions of France; as a liberal politician he appealed to the rising generations. In fact, in 1830, when the next French revolution came around, driving Louis XVI's brother from the throne, the people's choice was another Duc d'Orléans, the erstwhile Duc de Chartres, Louis-Philippe, eldest son of Philippe. And he reigned for 18 relatively tranquil and prosperous years, as a

Louis XVI, disguised as a valet in round hat, wig, plain coat, surrenders to guardsmen in Varennes, 1792.

middle-class and not-in-the-least-colorful citizen king.

The trouble was that France in the 1790s needed not just an amiable figurehead, full of radical chic, but a leader. A whole nation was soon to be in convulsion in an atmosphere of increasing distrust and violence, runaway inflation, civil war and finally war with all of Europe. Crisis followed crisis, and at any of them Philippe d'Orléans might have been expected to step forward. But he merely watched while opportunities slipped by. In the early days of 1789, when everyone else was loudly debating the future of the nation, he was taking his mistress, Madame de Buffon, to the theater or for rides in the country. On July 13, when his employee Camille Desmoulins called up the spirits of revolt from the duke's gardens in the Palais-Royal, the duke himself was away fishing. After rumor implicated him in the rioters' October march on Versailles, he acceded to royal wishes and exiled himself to England for nine months. In June 1791, when the royal family tried to sneak out of the country and was caught at Varennes and dragged ignominiously back to Paris, Philippe showed himself rather ostentatiously around the streets of the capital. But no one took any particular notice of him, and he went back indoors.

Escape attempt, depicted in countless melodramatic renderings like this, galvanized antiroyalist sentiment.

He went on espousing liberal ideas and making all the proper revolutionary gestures. He voted for the abrogation of feudal privileges, he voted for the Rights of Man, he voted for war against Austria. He joined the Jacobins, the most radical of the political clubs. When elections were held in 1792 for the Convention—the new assembly that was to govern the country and draw up the Constitution of the first French republic—he was elected 24th on a slate of 24 candidates in Paris headed by Robespierre. He felt uncomfortable with the Orléans family name, with all its feudal connotations, and the revolutionary coalition, the Commune of Paris, allowed him to change it. The name conferred on him—Egalité—must have had an excessive, if not ridiculous, ring to it even then. His eldest son, the Duc de Chartres, became General Egalité and went off to fight as a lieutenant of General Dumouriez, who was clearing the Austrians out of Belgium.

*When one "*Oui*" resonated with doom*

As the revolution picked up speed and became more and more sanguinary, like many aristocratic liberals who eventually were put to death too, Philippe looked more and more like a sorcerer's apprentice, helplessly buffeted by the forces that he had helped to unleash. The France where Philippe had hunted and caroused became one great killing field in 1793 and 1794, as the massive bloodletting known as the Terror commenced. In an age of outsize, outrageous and savage personalities, the Robespierres and Marats and Dantons, he was not in the league.

As deputy to the Convention, Citizen Egalité unwaveringly supported the Jacobin agenda. He voted for the creation of the tribunal which in a few months would condemn him, Camille Desmoulins and thousands of others to the guillotine. He voted with the large majority that found King Louis XVI guilty of treason. When it came to fixing the penalty, the majority for death was 75 votes; and though 394 deputies voted for execution, it was natural that the "*Oui*" of Citizen Egalité, the king's cousin, sounded with particular resonance.

The king took the news with gentle forbearance. "It really pains me," he said to the barber who was giving him his last haircut, "to see that Monsieur Orléans, my kinsman, voted for my death." He preferred not to dwell on it, though he worried about the servants who would have no income when he was gone.

One among the Terror's 40,000 victims, Philippe Egalité faced death with courage in November 1793.

The execution of the king, in January 1793, brought no comfort to Philippe, who rightly feared that he might soon be a victim of the antiroyalist hysteria. On February 10, he proclaimed that he was not the son of the fat Duc d'Orléans at all; his biological father, he protested, had really been a coachman named Lefranc.

Calling his mother a whore won him no credit with his revolutionary colleagues. Neither of the opposing factions, radical Jacobin or more moderate Girondins, wanted to claim him. "The slime," said Danton, "makes me sick to my stomach." He was, in fact, becoming something of an embarrassment to Jacobin leaders like Marat. The Girondins (so called because many of their leaders came from the *département* of the Gironde around Bordeaux) were always accusing the Jacobins of being on the Orléans payroll and of secretly conspiring to bring Philippe to the throne. Finally the Girondins set in motion the condemnation of Citizen Egalité.

By then the revolution was being drowned in blood and terror. The Jacobins would liquidate the Girondins in a murderous frenzy. And arch-Jacobin Robespierre, who had dispatched so many to death, ended up at the guillotine in 1794.

At first, delegates to the Convention had been protected by parliamentary immunity. But on April 1, 1793, a decree was voted (with Citizen Egalité's usual "*Oui*" among the rest) that permitted the arrest of any deputy "with strong presumptions of complicity with the enemies of Liberty." There was no evidence of any kind against Philippe, but it was easy to find presumptions. General Dumouriez, deprived of his command by the Convention and summoned home to Paris, had judged it more prudent to go over to the Austrians, and General Egalité had gone with him.

On April 6 the arrest decree arrived as Philippe was dining on sole with his friend de Monville. "What ingratitude," he exclaimed. De Monville squeezed a lemon on his sole and said, "That is what they are going to do with you." Soldiers dragged Egalité out of his bed at the Palais-Royal early the next morning.

In all, the revolution killed 40,000 people in the name of Liberty, Equality and Fraternity. The execution of Philippe was one among many. Judgment before the revolutionary tribunal was a formality. Philippe was not naive enough to expect either a fair trial or mercy. He had been trained to gallantry, and he was gallantly stoic through the long ordeal. First they sent him off to Marseilles, a calvary of a voyage during which he was hooted at and reviled at every stop along the way. After some months spent dirty and unkempt in an unheated cell, he was brought back to Paris and formally condemned to death. Since they had confiscated all his property, he did not have enough money to order the traditional last dinner, though he did insist absolutely on getting his hair cut and powdered.

By this time the violence and cruelty that fueled the revolution, encouraged by successive leaders, was completely out of hand. The men and women who made the French Revolution had succeeded in making a mess of their own lives as well as of the causes they espoused, but when their turn came to be destroyed by the machinery they had set in motion, most of them died with style. Philippe showed no sign of emotion as the tumbril took him to the scaffold with some prisoners of lesser rank—for revolutionary justice made no distinction between sons of dukes and sons of coachmen. When they had trouble pulling off his boots, he told them to take their time, it would be easier to get them off his corpse. Then he said to the executioner, "Make it quick."

Dr. Joseph Guillotin had made his great invention just for this purpose. The head was quickly severed and held up to the crowd that filled what had once been the Place Louis XV, was now the Place de la Révolution and would later be christened the Place de la Concorde. On November 7, 1793, one last time a great cheer went up at the sight of Philippe d'Orléans. It was the first time it had not been paid for.

Savage British cartoon accuses Philippe of atrocity he didn't commit—displaying king's severed head.

*By David M. Schwartz*

# It takes more than repellent to make flying pests bug off

*It takes a combination of things, and for the better part of a century scientists have been trying to dope out what they are*

For the Everglades in May, it's a beautiful day: temperature in the 70s and humidity so low that my T-shirt is still dry after a half-mile hike to the test site. The forest is ringing with birdsong, there's a gentle breeze, the trail is dappled by sunlight filtering through the overarching mangroves. The morning is so gorgeous, in fact, that Carl Schreck is in a stew. "It's a beautiful day for boating, hiking, touring—anything but what we're doing."

What he is doing, with the help of six colleagues, is testing new insect repellents in a place where insect repellents are usually about as essential to visitors as scuba tanks are to frogmen. He is worried that there may not be enough insects around this morning for his repellents to repel. "We're not just looking for a few mosquitoes buzzing around your head," he says as he rolls a pant leg up to his knee. Although the repellents applied to their clothing and the exposed areas of their skin protect most of these experimenters from dive-bombing mosquitoes, they must bare their lower legs once an hour to determine the level of insect assaults. In the 60 seconds Schreck's trouser leg is up, his calf sustains a paltry seven bites. He is disappointed. "We want the worst possible scenario," he explains. "It's too easy to make insect repellents look good if you don't challenge them."

When he's not offering free meals to blood-feeding denizens of the Everglades, Schreck does much the same sort of thing with caged mosquitoes some 300 miles away in Gainesville, Florida. At the Insects Affecting Man and Animals Research Laboratory of the U.S. Department of Agriculture (USDA), Schreck and his predecessors have screened more than 36,000 potential insect repellents. The two most promising candidates to emerge in more than 45 years—one for clothing and one for skin—are now being worn by his entourage in the Everglades. The day before I arrived, when the temperature and humidity had been higher, and both Schreck and the mosquitoes happier, some of the experimenters had suffered 100 bites on their untreated calves in just 15 seconds. Yet, in the face of that blitzkrieg, the trial repellents had worked magnificently: once the experimenters covered up, those wearing both repellents got off bite-free.

The tests were being conducted jointly by the USDA and the Department of Defense, which has been beating the bushes for a better bug juice since before World War II. "When people think of the adversaries faced by our Armed Forces, few think of mosquitoes or other arthropods," says Lt. Col. Lyman Roberts, former product manager for insect repellents at the U.S. Army Medical Materiel Development Activity in Fort Detrick, Maryland. "But historically, we've lost more people to disease than to bullets, and a very large percentage of those diseases are transmitted by arthropods. We have an urgent need for repellents better than those we are now using."

Although the compounds I saw in action are the offspring of 20th-century technology, there is nothing new about the search for better protection from enemies infinitesimal in size and infinite in number. The simple flyswatter, a technological advancement over the flailing hand, may qualify as the first insect repellent. Fans and featherdusters, used to keep insects away, were probably just a few millennia behind. Some were beautiful as well as practical, as can be seen in ancient drawings of attendants waving elaborate fans above the sleeping princess.

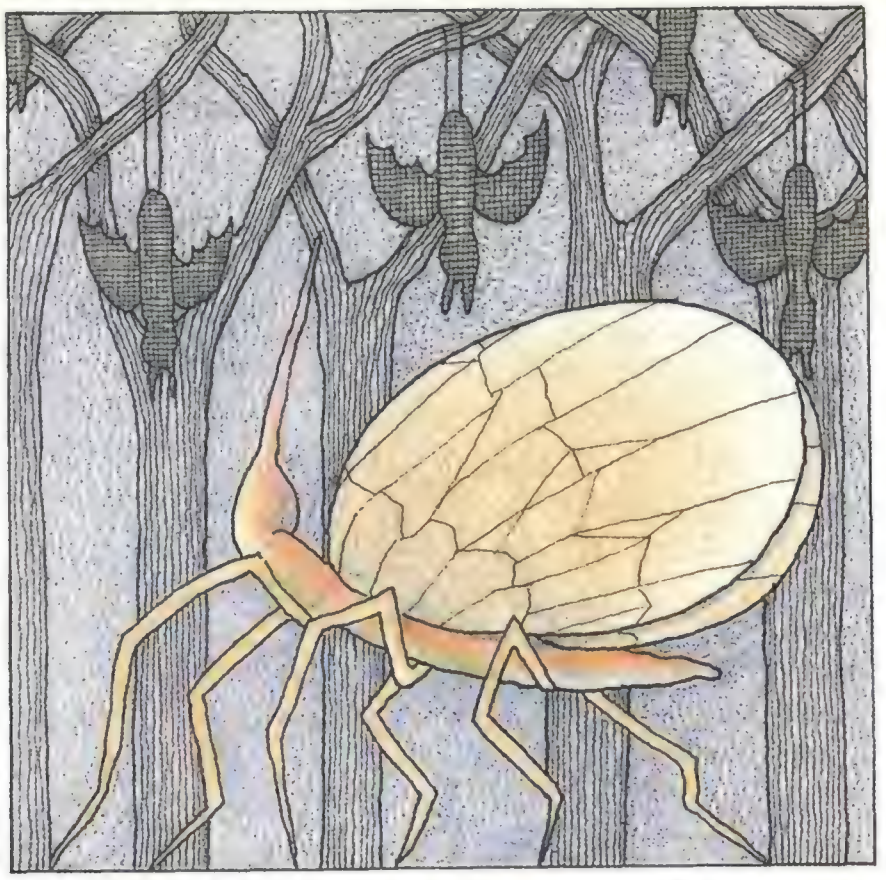
### *Debating the relative merits of smoke*

With the discovery of fire came the discovery of smoke, a not entirely unpleasant byproduct soon employed as Man's first chemical insect repellent. It's easy to imagine heated discussions of the merits of various smudges and aromatic woods at keeping bugs at bay—debates that persist to this day in backyards and campgrounds.

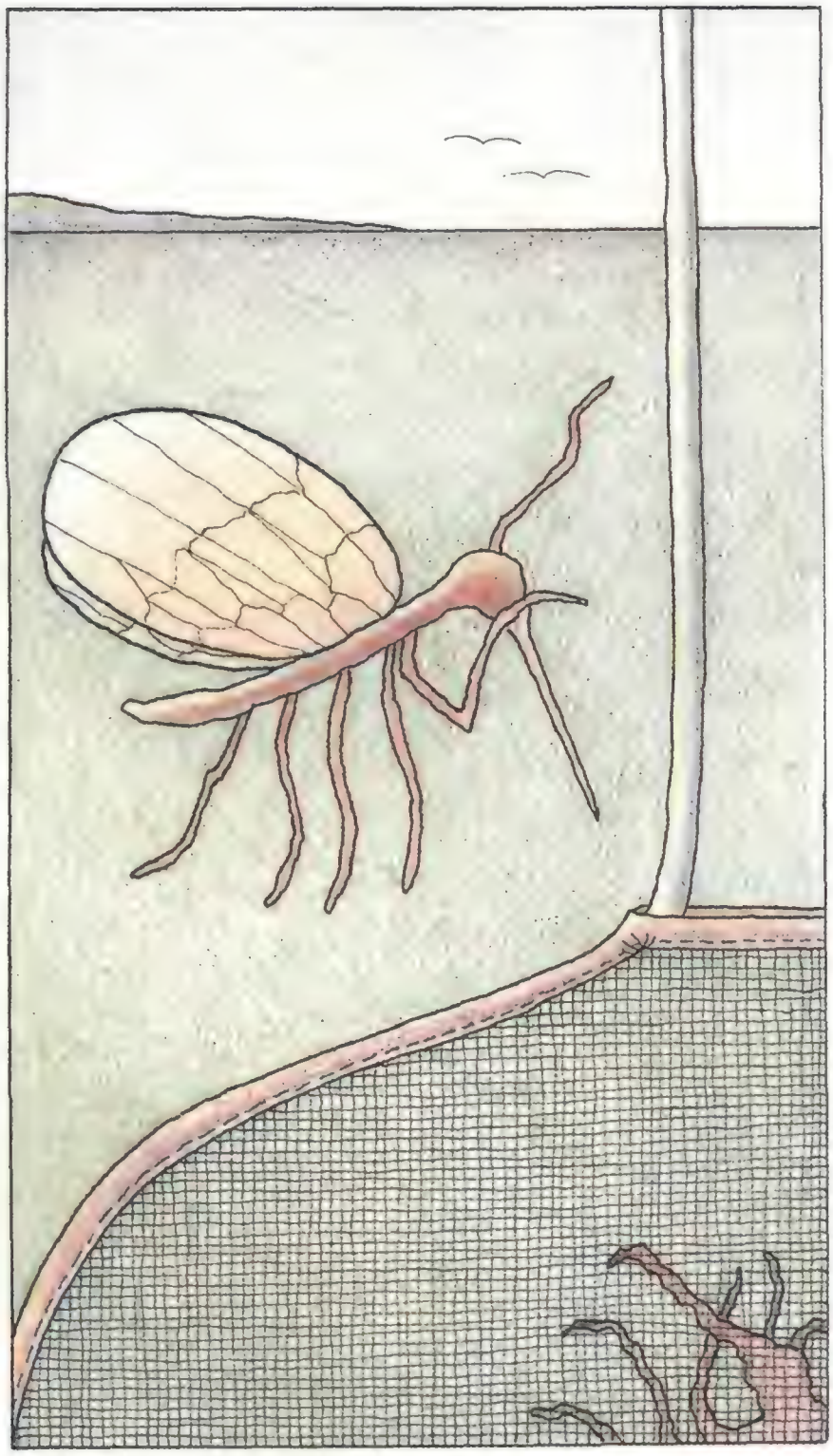
In the *Geoponika,* a collection of classical Greek agricultural writings published in the sixth or seventh century A.D., the salt alum was touted for its repellent properties. Flies were said to vanish wherever it was sprinkled. The book also claimed that locusts would be deterred from landing if live bats were tied to tall trees. Folklore is rich in accounts of botanical preparations credited with the ability to tame tiny beasts, and

To test new insect repellents, researchers in Florida are baring their skin to mosquitoes. The most promising approach involves using a repellent for the skin and a toxicant for clothing that kayoes pests on contact.

*Illustrations by Margaret Scott*



According to Greek folklore, locusts would be deterred from landing if live bats were fastened to tall trees.



The flyswatter, a technological advancement over the flailing hand, may qualify as the first insect repellent.

many of the claims have stood up to scientific scrutiny. Over the years, extracts of peppermint, vanilla, bay, clove, sassafras, cedar, eucalyptus and scores of other plants have had their champions, but the granddaddies of them all are the oils of pennyroyal and citronella. A limerick of uncertain origin bespeaks the unforeseen benefits of one:

> There was a young girl named Estrella,
> Who said, "Stick around me, young fella.
> "The mosquitoes, they bite,
> "They are awful tonight,
> "And you smell just like citronella."

Often surviving for weeks or months on little more than their wilderness savvy, the woodsmen of the 19th century were a hard-bitten lot, and—if you believe their yarns—hardly bitten. Each seemed to have his own personal insect formula. Old Time Woodsman Fly Dope, a commercial preparation still available in the Northeast, harkens back to the age when outdoorsmen took extended sojourns in the woods; one whiff of it may explain why those sojourns were so often solo. George Washington Sears, a shadowy backwoods character who published under the evocative pseudonym Nessmuk, boasted that just one ounce of his concoction—pine tar, castor oil and pennyroyal oil—afforded him six weeks' protection from the "venomous little wretches." "I have never known it to fail," he wrote in his 1888 book, *Woodcraft.* "A good safe coat of this varnish grows better the longer it is kept on." In order to cultivate such a veneer, Nessmuk readily compromised personal hygiene: "Last summer I carried a cake

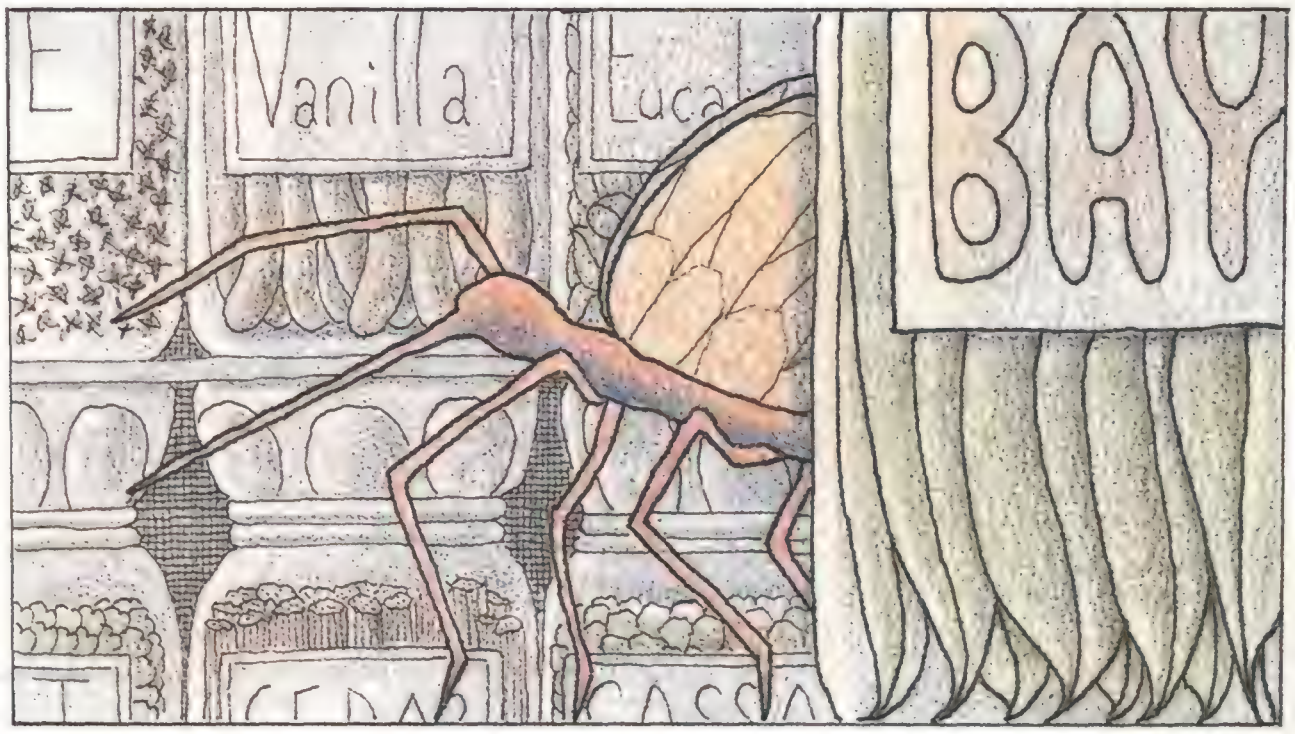
of soap and a towel in my knapsack through the North Woods for a seven weeks' tour, and never used either a single time. When I had established a good glaze on the skin, it was too valuable to be sacrificed for any weak whim connected with soap and water."

The pursuit of repellents is more systematic these days but, as with many scientific discoveries, some of the most intriguing possibilities have been revealed serendipitously. Sam Chema is the former director of Kenya's Veterinary Research Laboratory. While studying the incidence of trypanosomiasis in native wildlife six years ago, his researchers were surprised to find none at all in the large, swamp-dwelling antelope known as the waterbuck. The disease, which is fatal to humans (as the so-called African sleeping sickness) and other mammals, is caused by trypanosomes. These protozoans are spread from one host to another by the tsetse, a bloodsucking fly distantly related to mosquitoes. "There are two obvious possibilities," Chema explains. "Either the waterbuck is immune to the disease, or it has a way to avoid being bitten by the tsetse."

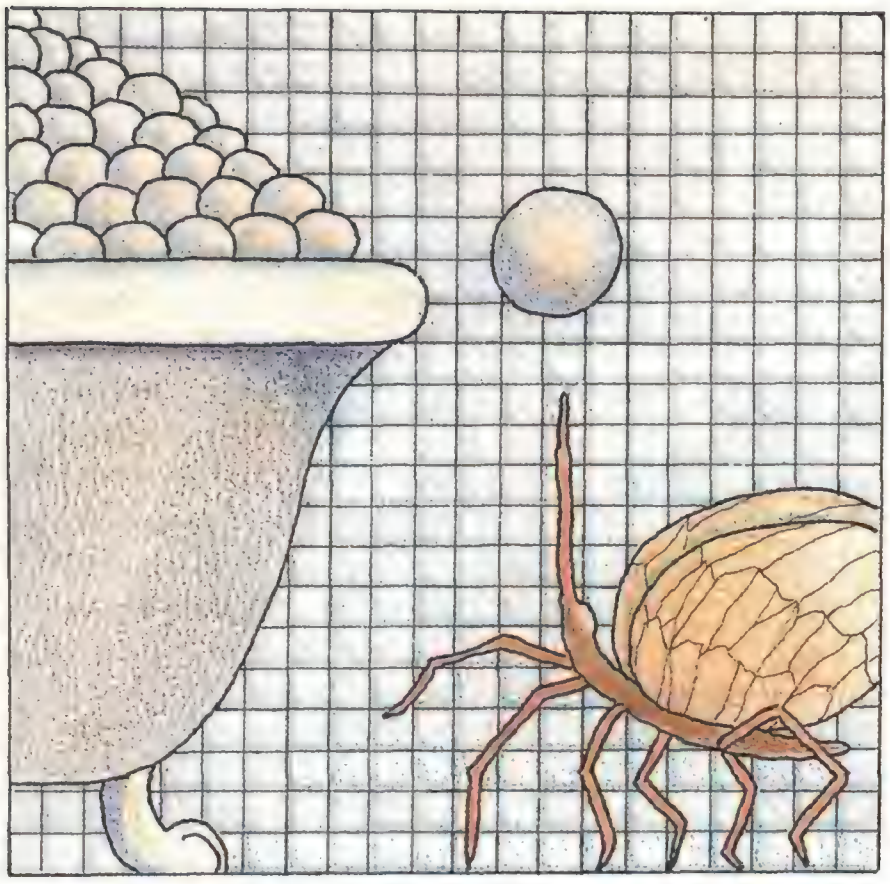
The researchers took a few waterbuck into captivity and injected them with trypanosomes. A number of them came down with the disease. Having thus eliminated the possibility that the animals are immune, Chema then wanted to find out if they give off a natural insect repellent. His plan was to wash down waterbuck with various solvents, concentrate and distill the wash, and confirm its repellency. It could then be analyzed chemically and the active ingredient identified. The project has yet to materialize but think about it: the day may come when no one would even dream of venturing into tsetse country without a handy vial of "essence of waterbuck."

Today at the Letterman Army Institute of Research (LAIR) in San Francisco, researchers use robot-operated chemical assay systems, climate simulation chambers and other computerized equipment to evaluate the newest synthetic (and natural) repellents for effectiveness, longevity, evaporation rate and other factors. They also investigate low-tech formulations from every corner of the globe. "You have to do some kind of test before you can be sure," says Louis Rutledge, director of insect repellent research at LAIR. I am visiting his lab to watch tests of repellents on ten different pest species. "Of course, much of the time it turns out to be something we already know about." Rutledge's assistant, Maj. Raj Gupta, proffers a tube recently sent in by military intelligence sources in Thailand. I uncap it and sniff the unmistakable aroma of citronella. On the shelves of Gupta's office—not far from a sign that reads "Project Bugaway"—I see an aerosol can from Japan, a soap from Australia, a vial of oil from India and a small pharmacy of other products, several labeled in alphabets I don't recognize. Some are new, some old; some will work, some won't. All contain an elixir somebody somewhere thought to be the bug juice equivalent of a better mousetrap.

"It isn't difficult to find substances that repel insects," Rutledge says. "What's difficult is finding a truly useful repellent." To be useful, it must be long-lasting, nontoxic, cosmetically acceptable, and highly effective against a broad spectrum of crawling and flying pests, from chigger mites and ticks to biting midges, black flies and mosquitoes. A few years ago, a bath oil manufactured by Avon developed a surprising reputation as an insect repellent. While hard-core military types might have blanched at the notion of anointing their bodies with anything called Skin So Soft, the rumors were so persistent that it too came in for LAIR's objec-




Over the years, various botanical concoctions have been credited with the ability to discourage pests. These include extracts of vanilla, bay, sassafras, clove, eucalyptus and scores of other plants. The best known are probably citronella and pennyroyal.



At one time, rumor had it that a well-known bath oil kept insects away, but it did not work well in tests.

tive scrutiny. After a battery of tests, Rutledge concluded that it did have some repellency, but standard repellents on the market outperformed Avon's Skin So Soft 30 times over.

Tests have shown that the venerable botanicals work, too, but not well and not for long. Some, like oil of sassafras, can be highly irritating to human skin. Most work best when insect densities are low.

In the 1920s, the chemical industry took up the challenge of improving upon the best of the known botanicals, and by World War II the arsenal for combating biting arthropods included, in addition to citronella, three synthetics: dimethyl phthalate, Indalone and ethyl hexanediol. (The latter was nicknamed "Rutgers 612"—later, just "6-12"—after the university that confirmed its repellency and the experimental number of the bottle that contained the trial sample.) During the war, these three compounds, mixed in a ratio of 6:2:2 and designated "6-2-2" were bottled and issued to G.I.'s who carried them around the world in their shirt pockets.

The 6-2-2 compound was hailed as the all-purpose military repellent, but it failed miserably. In the Pacific, escalating numbers of fighting men were succumbing to dengue fever, malaria and other mosquito-borne diseases. Something better had to be found. The quest continued at the USDA's Entomological Research Branch in Orlando, Florida, the predecessor of the Gainesville lab. All compounds were given classified code numbers, as if they were battle plans.

Conveniently, the Orlando facility was near a military base, a ready source of "volunteers." For those subjects, a day's work consisted of rolling up a sleeve, applying a prospective repellent and plunging an arm into a cage of 500 mated female mosquitoes hungry for a blood meal to nourish their eggs. As soon as two of the insects had their way with the arm, it was withdrawn, washed, smeared with another compound and sent back to its buggy workplace. If it went unprobed by mosquito stylets for three minutes, it received a 30-minute respite before confronting the buzzing hordes again. In this way, ineffective chemicals could be discarded rapidly and propitious ones evaluated for longevity. Those that appeared most promising were subjected to further testing for toxicity.

The candidates came from all over the country. "Anyone who was making a repellent, or anything they thought might be a repellent, cleaned off their shelves and sent it all to us," recalls Carroll N. Smith, the former director of the USDA lab. About 20,000 compounds later, shortly after the war ended, something truly superior emerged. Entomologists at the USDA's Beltsville, Maryland, lab produced a new compound that turned out to be effective against more species than anything previously known to man or bug, and for practically twice as long. Chemists referred to it as "*N,N*-diethyl-*meta*-toluamide" or, when they were in an informal mood, "diethyl toluamide." The rest of the world soon knew it as "deet."

"Compared with everything else out there, deet was a magic bullet," recalls Roger Grothaus, then a medical entomologist with the Navy and now the director of insect research at S. C. Johnson Wax. In 1957, the Racine, Wisconsin, company became the first to market deet, under the trade name Off! Three years later, Cutter Laboratories followed, putting deet into a pleasant-smelling white lotion that quickly found favor with sportsmen and backpackers, whose number included company president Robert K. Cutter, an active Sierra Club editor. Today these two products, Off! and Cutter, continue to dominate the market, their active ingredient unchanged. "What's most fascinating," says Grothaus, "is that deet has been so difficult to top. Since 1957, we've been looking for that 'factor X' that improves upon deet as much as deet improved on what came before. We're still looking."

For the moment, the Armed Forces figure that if deet can't be beat, it can at least be made to last longer. Four hours is not long enough to protect a soldier in combat or asleep in a bivouac. Contracting with the 3M Company, military entomologists have developed

*David Schwartz, a frequent contributor, fed mosquitoes in California, Connecticut and Florida while doing the research for this article.*

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an extended-duration deet formulation in which long polymer chains of an inactive ingredient bind the repellent molecules and slowly release them into the air over a period of 12 hours. It was this product, dispensed from olive-drab tubes, that the members of Schreck's Everglades crew doped up with at 7 every morning. It's dubbed EDTIAR for Extended Duration Topical Insect/Arthropod Repellent. By the end of this year, around a million tubes should be in the military supply system.

Unfortunately—or, from Carl Schreck's point of view, fortunately—the day in the Everglades that started out so gloriously soon heated up. By late afternoon, just about the time the EDTIAR began to fail, the air was thick with mosquitoes. "I'm overjoyed," Schreck exclaimed after counting 26 bites in one minute on his bare arms. Hearing the cries of one of his co-workers, he added: "So's Dan over there."

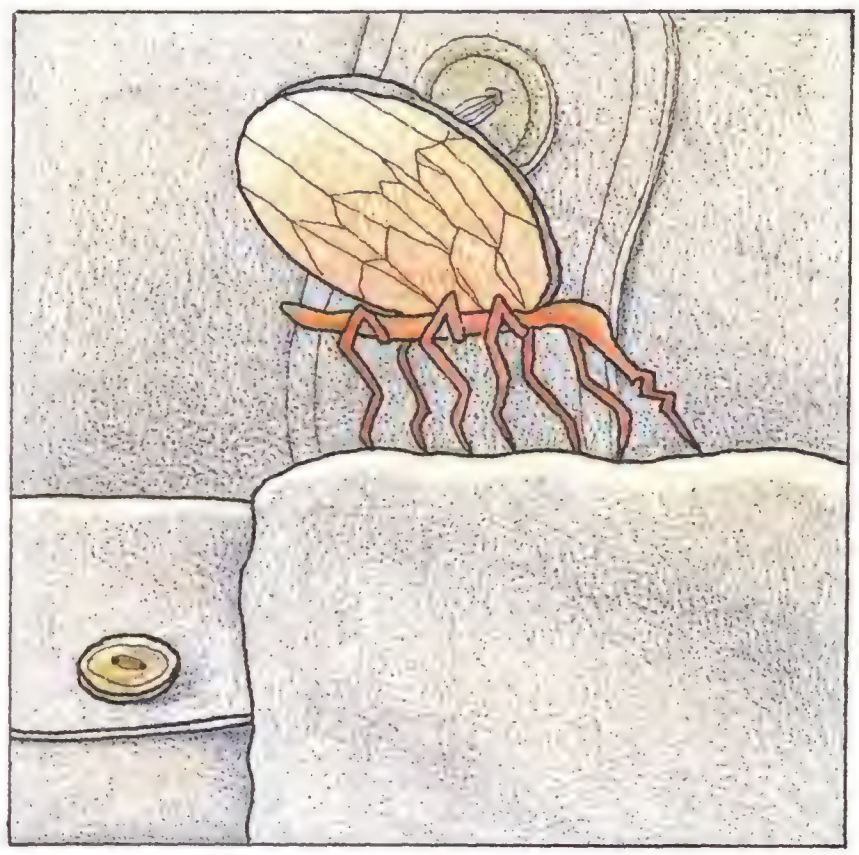
"I can't walk another step, I'm anemic," moaned Dan Smith, a technician in Schreck's lab who, according to the experimental protocol, was serving as a control during this part of the test and was therefore not allowed to use any repellent. Instead, he wore long sleeves and a head net, and lifted each for one minute out of every 15. (All the experimenters had to do equal time as controls—one day a week.) Smith had just sustained 115 bites and he wasn't about to let his misfortune go unnoticed by his colleagues. "Help me, I just lost two pints of blood!"

Fortunately for them (except when they were controls), Schreck, Smith and the others had more than mere deet with which to parry the probes and punctures of the mosquitoes. They also had permethrin, the compound that is generating the most excitement in insect repellent research these days. Technically, permethrin is not a "repellent" like deet. It is a toxicant. "You can spray it on your arms and you'll get almost as many bites as you would on untreated skin," Schreck explained. "But put it on your clothing and it's death to insects." Marketed primarily to ward off ticks, which can carry Lyme disease (SMITHSONIAN, April 1986) and Rocky Mountain spotted fever, permethrin is licensed for sale as an aerosol spray in 29 states under the trade name Permanone Tick Repellent.

About 15 years ago, permethrin was found to turn ordinary cloth into arthropod-proof armor. It had an extraordinary adherence to cotton fabric and maintained its potency through ten or more washings. As a contact toxicant, it knocks down most insects that crawl or land on it—not immediately, but in the time it takes a mosquito to probe your shirt for underlying skin, it's a goner.

This point was graphically illustrated in the Everglades by one of the experimenters, who pointed out a mosquito that had buzzed his nose, alighted on his shirt and taken a drunken flight to his clipboard. We watched it desperately attempting to clean its legs as it turned increasingly wobbly cartwheels. Minutes later, it was "Goodbye, Charlie," as the poisoned insect dropped to the ground. Sometimes, Schreck noted, ants cart off the dead mosquitoes and within seconds they too start walking a woozy path.

Deet and permethrin work well together: deet repels insects from treated skin to clothing, where permethrin zaps them. This combination has actually been shown to make a major dent in mosquito populations. In 380 mosquitoey acres of a park in New Smyrna Beach,



The toxicant known as permethrin adheres to everyday clothing, transforming it into an insect-proof armor.

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| 1232651. Dutch | 1232743. Korean | 1232834. Tagalog (Filipino) |
| 1366665. Finnish | 1429224. Latin | |
| 1232669. French | 1232750. Norwegian | 1363316. Thai |
| 1232677. German | 1232768. Persian | 1232842. Turkish |
| 1232685. Greek | 1300375. Polish | 1232859. Vietnamese |
| 1232693. Hebrew | 1232776. Portuguese | 1516541. Yiddish |
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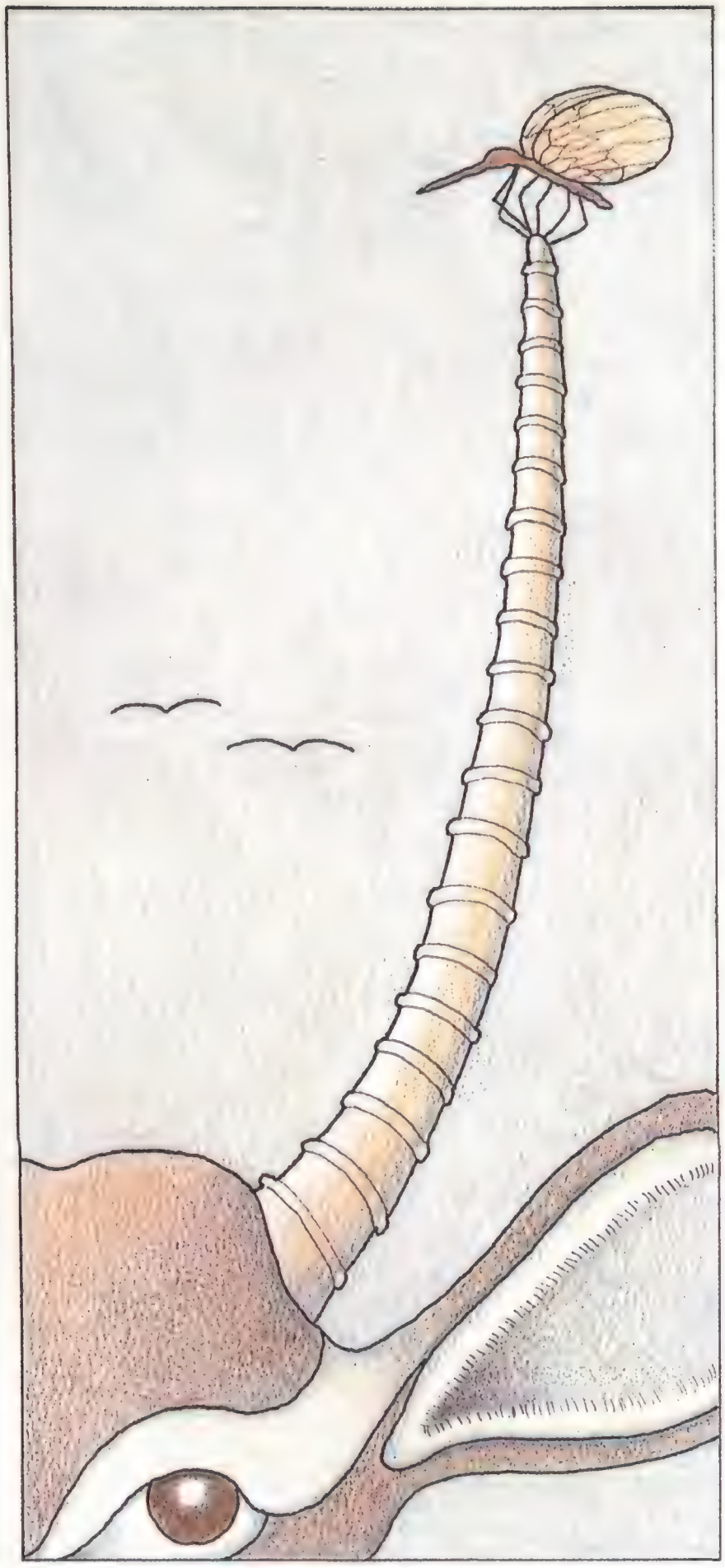

Research suggests the African waterbuck may produce a natural repellent that makes the tsetse stay away.

Florida, eight doubly dosed experimenters walking a meandering path for a day wiped out 94 percent of the biting mosquito population.

The Army, which underwrites and oversees this new military repellent research, refers to the joint approach as the "total personal protection system." "Nothing we've ever seen comes close," says Col. John Reinert, an Army entomologist for 27 years. In the Everglades, those serving as unprotected controls received several hundred bites per minute. Test subjects armed with EDTIAR and permethrin enjoyed virtually total protection—not a single bite for the first nine hours of each day, when the deet ran its course.

A month after I joined him in the Everglades, Schreck went to Pakistan as an epidemiological consultant, advising health-care workers on the use of permethrin to combat diseases transmitted by insects. Studies this year by the World Health Organization have produced evidence that the compound (and others like it) can significantly reduce malaria transmission, and Schreck is guardedly optimistic. "When you consider that they can be used not only on clothing but also on bedding, curtains and the nets people sleep under," he says, "I expect we'll be seeing permethrin and certain other compounds take on increasing importance in public health."

*Mosquito-borne disease: a growing threat*

If so, it comes at a propitious time. The cost of pesticide spraying is too high for most Third World countries, and the pests' uncanny ability to develop resistance is all too familiar. Contamination and environmental degradation have provided additional reasons not to spray. Yet, the escalating numbers of discarded automobile and truck tires—hundreds of millions every year—provide ideal breeding sites for mosquitoes. As a result, the incidence of mosquito-transmitted disease is on the rise. In 1987, the Western Hemisphere saw slightly over a million cases of malaria, 13 times as many as in 1960. In India, 1,611,189 people now suffer from the disease, as compared with 59,575 at the height of mosquito eradication 30 years ago. "We can no longer hope to solve these problems with only insecticides," says Francisco Lopez-Antonano, coordinator of the Pan American Health Organization's communicable disease program. "The future is in sanitary engineering, proper water management, promotion of river fishes that feed on mosquito larvae, and personal protection through the use of permethrin and repellents."

For all the promise of the new double-barreled protection system, the search for even better repellents continues. As good as it is, deet is not perfect. It irritates mucous membranes and imparts an oily, sometimes sticky feeling that some people find objectionable. It's also a solvent for many plastics—ask any deet user who has left permanent fingerprints on a pair of eyeglass frames, or whose legs have stuck to the vinyl seat of a car. And even though it works against many arthropods, some (notably malaria mosquitoes and large biting flies like deer flies) are less susceptible to its effects. Consequently, several hundred potential deet substitutes are put to the test every year by the

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Gabriel Cortez
Colombia
Age 4

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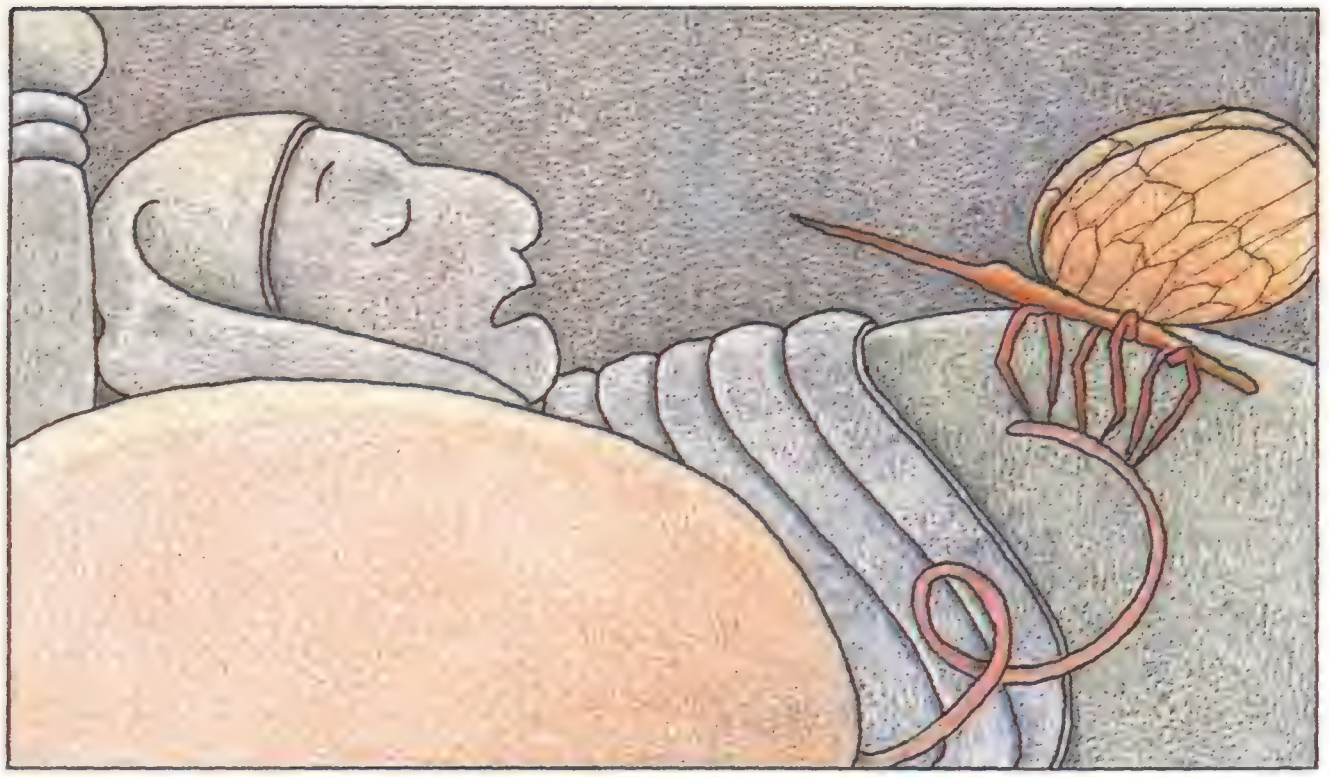


An old Italian adage has it that people who sleep in a room with a pig are unlikely to contract malaria. Research confirms that people with higher skin temperatures and moisture transpiration do attract mosquitoes.

USDA, LAIR and private firms. A few have outperformed deet, but they haven't gotten the green light in toxicology studies. The search goes on. But some scientists think screening compounds by the bucketful is a circuitous route to the elusive "factor X." Instead, they are pursuing comparatively neglected areas of basic research that attempt to teach us how a mosquito finds its meal in the first place, and how a repellent gets in its way.

"The real problem is that we don't know how insect repellents work, so we can't develop a strategy to make better ones," says biologist Edward Davis of SRI International (formerly Stanford Research Institute) in Menlo Park, California. "Nor do we understand the molecular interactions of attractants with receptors on the mosquito's antennas. If we did, we could try to build repellents that interfere with them. But first we have to see what's going on with the bug."

Davis is certainly not the first to try to understand attraction and repulsion in insects. In the 1940s, the British entomologist J. D. Gillett made an observation he thought might explain the old Italian adage that says people who sleep in a room with a pig are safe from malaria. Camping in Africa on the north shore of Lake Victoria, he noticed as many mosquitoes hovering around his pot of hot shaving water as around him. To make his morning shave comparatively peaceful, he placed another pot of hot water about six feet away as a decoy. Could heat and humidity, he wondered—whether from water, human or pig—be the important factors that draw mosquitoes to their target? Recalling the Italian saying, he wrote, "Perhaps the higher temperature of the pig attracts the visiting *Anopheles* away from the sleeping man."

Some 30 years later, a Canadian chemist, R. H. Wright, put Gillett's speculation to the test and found that indeed people with higher skin temperatures and higher moisture-transpiration rates attract more mosquitoes. (This may help explain the oft-heard complaint among spouses that one never suffers a bite while the other attracts every mosquito in the neighborhood.) By placing yellow-fever mosquitoes in a wind tunnel, Wright also found that carbon dioxide serves to activate them from the resting state and, once alerted to a carbon dioxide source, they fly at random until they enter a plume of warm, humid air; when they subsequently encounter cooler, drier air, they turn sharply to reenter the warm current.

But in an experiment at his Gainesville lab, Carl Schreck demonstrated that there's more to the story than heat, humidity and carbon dioxide. Those factors may help guide a mosquito to the general vicinity of its host, but they don't seem to be sufficient to get it to land, probe and sip. Nor do they appear to be the only emanations a mosquito senses. For years it has been suspected that some component of human odor also draws them in. Schreck had people run their hands through a container of glass marbles. To see if an odor factor was transferable, he washed the marbles with organic solvents and evaporated the solvents on a glass plate. The residue attracted 81 to 95 percent of the mosquitoes involved in a test. Some people, he found, left a more attractive residue than others, lending further credence to the cries of indignation by mosquito-visited spouses. "If we can identify the skin chemical mosquitoes respond to," Schreck speculates, "then we can try to find something that cancels a person's attractiveness."

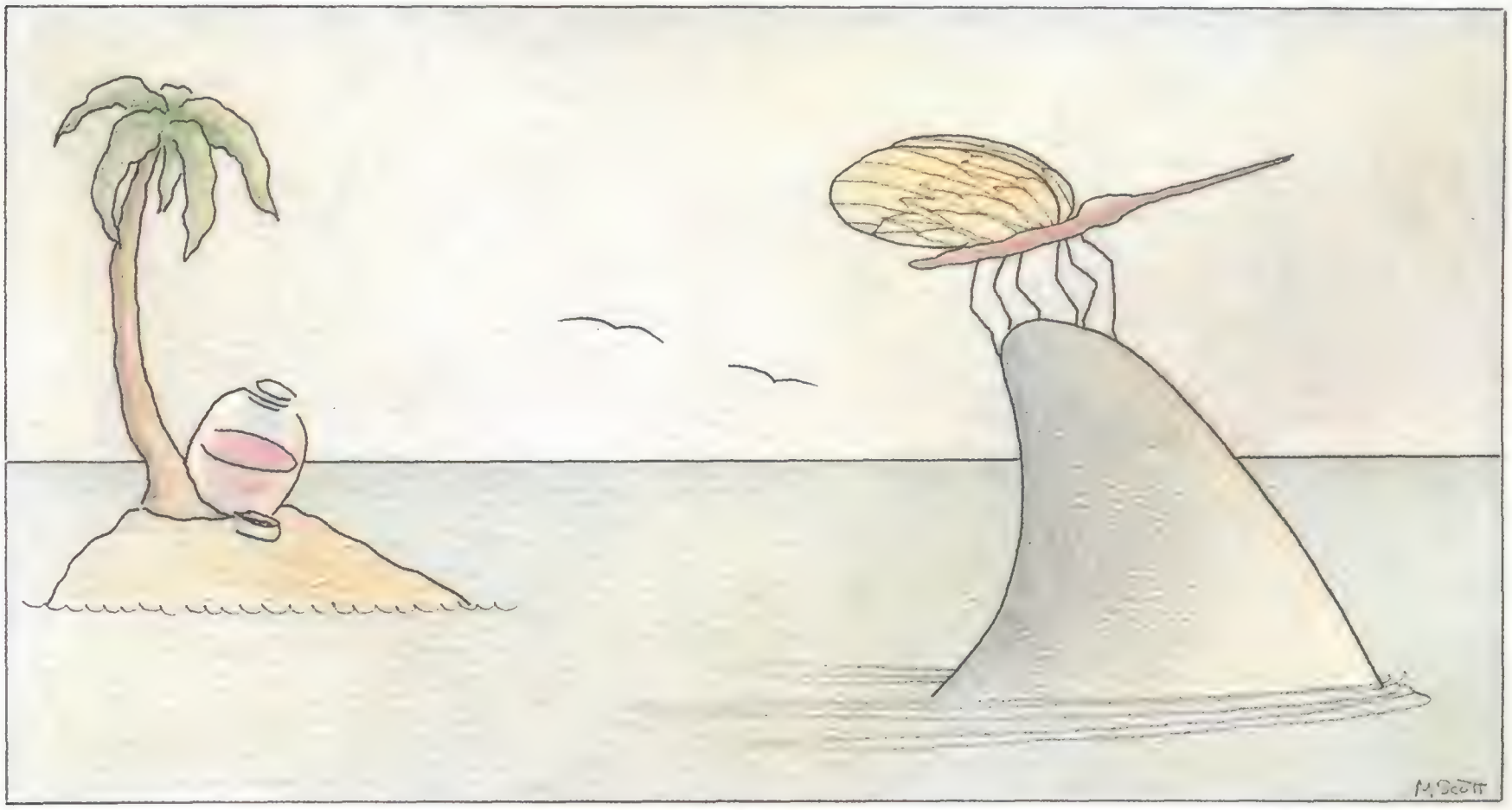
At SRI International, Ed Davis tackles the same basic problem through a mosquito's nerves and hormones. Using microelectrodes, he takes readings off olfactory receptors in the insect's antennas, and he has found a pair of neurons exquisitely sensitive to lactic acid, a common metabolic byproduct that humans release through the skin. Relying on these receptors, a mosquito placed in an airstream permeated by lactic acid will fly directly to the source. But if deet is added to the acid-laden air, the receptor's sensitivity drops dramatically. Enough deet, and the mosquito can no longer detect lactic acid at all. It flies a slow, meandering course oriented to nothing in particular. This finding helps debunk the notion that insect repellents repel because insects can't stand the smell. Now it seems otherwise: it's not that the bugs don't like you, it's that they can't find you.

But artificial repellents aren't the only substances that block a mosquito's ability to detect a host's lactic acid. Davis has found that at certain stages in its life cycle, the mosquito itself produces chemicals that do exactly the same thing. Most people don't realize that both male and female mosquitoes get some nutrition by ingesting plant sap and the nectar of flowers. The females of most species also partake of blood meals when they require extra protein in order to produce and lay eggs. "Right after a blood meal, the female will be at risk if she tries to find a host again, so she must block that behavior," Davis says. To that end, some unknown hormone, triggered by some internal signal, lowers the sensitivity of the lactic acid receptor. After depositing her first batch of eggs, lactic acid sensitivity returns and the mosquito, seeking to maximize her motherhood, flies off in search of another unwilling blood donor.

Davis' current work attempts to identify the endogenous signals that turn the urge to feed on and off. Ultimately, he hopes we will be able to influence mosquito behavior by learning how to dispense the biological equivalent of disinformation. With a little clever chemistry, in other words, we may finally be able to answer "Yes!" to the question novelist D. H. Lawrence asked his tiny winged tormentor: "Am I not mosquito enough to out-mosquito you?"

Still, an unquantifiable multitude of mouthparts will sink into human flesh before any such advances are made. At Johnson Wax, researchers have had early but encouraging success at out-mosquitoing mosquitoes with a new generation of "smart" chemicals, but Roger Grothaus warns that many years stand between his test tubes and a bottle or spray can that you and I can pack off to the woods on a buggy evening. "In the meantime," he says, "I have the same answer I've always had to the old question, 'If you could take one thing to a desert island, what would it be?' It would be a bottle of deet."

An entomologist says if he were given the choice of taking only one thing with him to a lonely desert isle, it would not be a book or a musical instrument. It would be a good supply of deet to keep the bugs away.



Her form looks nearly faultless as Dorothy (Mickey) Maguire, catcher with the Muskegon, Michigan, Lassies, takes a healthy cut during a game in 1947. High hems, long socks were de rigueur in All-American League.

*By Jack Fincher*

# The 'Belles of the Ball Game' were a hit with their fans

*When the Girls of Summer played for pay, they proved women did not have to sacrifice their femininity to excel in a man's world*

Visitors to the Baseball Hall of Fame in Cooperstown, New York, were mystified one weekend last fall to behold an ebullient throng of older women trooping around the place as if they owned it. Which, in a manner of speaking, they did. Once, those senior citizens were the glamorous Girls of Summer—stars of the only professional female baseball league this country ever had. Playing for teams with such unabashedly sexist names as the Chicks, the Peaches and the Lassies, they swung for the fences, barreled down the base paths and signed autographs for their adoring fans just like big-league ballplayers. But they weren't merely shadows of their male counterparts. They added dash and excitement to the national pastime and, in so doing, made it uniquely their own. Sportswriters dubbed them the "Queens of Swat" and the "Belles of the Ball Game." They called each other "Moe" and "Tiby," "Nickie" and "Pepper," "Jeep" and "Flash." They rode stuffy buses from city to city, played six games a week and doubleheaders on Sunday, and dreaded the day in September when the grueling season would come to an end. Now, aging in body but

Doris Sams, another of the pennant-winning Lassies, unlimbers her arm during spring training in 1948. The previous year, Sams, who was a center fielder and pitcher, was voted the league's most valuable player.

The "Queens of Swat" have put on a few years since their playing days, but not many pounds. At top (from the left), Joanne Winter, Sophie Kurys, Carolyn Morris and Jane Stoll recapture a feeling for the game at a stadium in Arizona. Below, Sophie Kurys slides into second base during spring training. In bottom row (from the left), Joanne Winter, Carolyn Morris show their stuff in the days before the league went to overhand pitching, and Jane Stoll deftly snags a line drive for a publicity photograph.

ageless in spirit, they were in town to attend the unveiling of a new permanent exhibition in their honor.

Dedicated to "Women in Baseball," the intriguing collection of uniforms, photographs and trophies salutes the 545 athletes from the United States, Cuba and Canada who were part of the All-American Girls Professional Baseball League (AAGPBL) from its inception in 1943 to its demise 12 years later. It is an impressive tribute, and one so richly deserved that most of the heretofore unsung heroines can't understand what took so long. As one of them pointedly noted in Cooperstown: "It doesn't say 'Men's Baseball Hall of Fame,' does it?"

No, it most assuredly does not. But then, the Girls of Summer didn't always play as if they were destined to be enshrined in *any* hall of fame, men's or women's. Take, for example, the chilly night in June 1943 when the Racine, Wisconsin, Belles took the home field against the South Bend, Indiana, Blue Sox.

The setting was Horlick Field, a windy old wooden stadium near Lake Michigan with a hand-posted scoreboard and dim floodlights. At that early stage of the league's development, the girls were playing modified softball, not hardball. The distance between the bases was a little longer, there were nine players on a side (instead of the usual ten), and a runner was allowed to take a lead off base and steal. The Racine and South Bend pitchers pinned the high-hemmed skirts of their one-piece uniforms, so as to take nothing away from their speed and control, but they still had trouble getting the ball over the plate and holding runners on base. The fielders had problems, too, and when the comedy of errors was over, the Blue Sox had drawn nine walks and two wild pitches, made seven miscues, stolen 17 bases and won 12 to 6. "A crowd of 683 cash customers turned out despite the cool weather," reported the *Racine Journal Times*, "but the temperature was nothing compared to the chill they received from the two hours and 35 minutes of how *not* to play."

That, as it turned out, was the exception to the rule. The league went on to include as many as ten teams and attract more than a million enthusiastic fans a season. The pitching shifted to overhand in 1948, the ball got smaller, the base paths got longer and the caliber of play got better and better. Max Carey, a Pittsburgh Pirates Hall of Famer who managed the Milwaukee Chicks and was the league president for six years, called a 14-inning contest between the Rockford, Illinois, Peaches and the Racine Belles the "greatest" game he had ever seen, male or female.

It was the final meeting of the 1946 championship series. Pitcher Carolyn Morris of the Peaches had a no-hitter going for nine innings, but in the 12th inning Rockford manager Bill Allington took her out. Pitching for the Belles was Joanne Winter, who had survived one close call after another. "I was getting banged all over the place and watching my teammates make these tremendous plays behind me," recalls Winter, who now teaches golf in Scottsdale, Arizona. "They got 13 hits off me but never scored." The game was decided in the bottom half of the 14th inning when the Belles' scrappy second baseman, Sophie Kurys, slid across home plate with the winning run. "I got a base hit, stole second and was on my way to steal third when Betty Trezza [the Belles' shortstop] hit it into right field and I slid into home," says Kurys, a retired businesswoman also living in Scottsdale. "It was real close, but I was safe." Kurys stole 201 bases that year, a professional record no one in any league has even managed to approach.

*It wasn't all fun and games*

Ken Sells, the AAGPBL's first president, is a robust, 83-year-old retiree living in Paradise Valley, Arizona, not far from where several major-league baseball teams stage their spring training. He maintains that although female baseball players enjoyed themselves and made reasonably good money, they had a serious mission to accomplish. "They proved," he says, "that women didn't have to sacrifice their femininity to be standouts in what was then a man's world."

That's one of the things Philip K. Wrigley had in mind when he decided to start up a women's league in 1942. The chewing-gum magnate and owner of the Chicago Cubs baseball team was afraid the wartime draft might shut down the major leagues altogether; a number of minor-league teams had already been forced to suspend operations. If the big leagues did fold, Wrigley reasoned, it might be possible to transfer a professional women's league into those parks. But the major leagues got through the war years intact and consequently the AAGPBL remained in a number of smaller Midwestern towns and cities, where factory workers had money to spend but couldn't travel much because of gas rationing.

In the early 1940s, amateur softball leagues for women were thriving in thousands of communities all over the country. Wrigley decided to skim the best players off those teams, winnow the candidates down to a select few, and then use that reservoir of talent to set up his new play-for-pay league.

Wrigley contributed the major share of the start-up costs and also footed half the operating expenses of each team. (Local supporters in the four charter cities—Rockford, Illinois; Racine and Kenosha, Wisconsin;

*In January, Jack Fincher wrote about the 1918-19 influenza epidemic. He has also reported in these pages on lightning, radio mechanics and tumbleweeds.*

Merle Keagle of the Grand Rapids Chicks disputes umpire Al Chapman's call in Florida exhibition game.

and South Bend, Indiana—guaranteed the other half.) As a savvy baseball man and shrewd entrepreneur, he knew what he wanted and he understood how to go about getting it. He drew upon the Cubs organization for executive talent and scouts, and he persuaded his friend Branch Rickey, the respected general manager of the Brooklyn Dodgers (and later the Pittsburgh Pirates) to serve as an adviser and trustee.

Wrigley also understood the importance of image. His league would have nothing to do with the kind of short-haired, mannishly dressed toughies then touring the country on several all-girl barnstorming teams. As one of Wrigley's associates put it, the new league's athletes would be expected to epitomize "the highest ideals of womanhood." The order went down to Ken Sells, the Cubs' assistant general manager and head of the AAGPBL: at the league tryouts in Chicago that spring, Mr. Wrigley expected to see nothing but healthy, wholesome, "all-American" girls.

In May 1943, more than a hundred of the best female softball players in North America registered at the Belmont Hotel in Chicago, and then assembled for tryouts and spring training at the Cubs' Wrigley Field. Most of them were underage, overawed, homesick and as green as the outfield grass. Jane (Jeep) Stoll, presently a resident of Phoenix, went to Chicago as a recent high school graduate from rural Pennsylvania. "I had never ridden on a train," she says. "I sat up all night in a Pullman car because I didn't understand how that seat was gonna be my bed."

Sophie Kurys was 17 when she showed up in Chicago, a taciturn Polish Ukrainian from Flint, Michigan. "It was raining when I got there. I told them I wanted to turn around and go right back home. They moved me in with some older girls, and probably told them to mother me a bit. The next day the sun was shining and I felt fine."

Girls. It was always "girls," never "women," and in their recollections it remains so today.

*"Oh my, what nice eyes you have"*

The players soon found that they were in for more than they had bargained for. After getting up at dawn and working out all day, they were required to attend charm school in the evening. The classes were conducted by representatives of the Helena Rubinstein cosmetics company, who taught the athletes how to put on makeup, get in and out of a car, and put on a coat with seemly grace. The girls also learned how to enunciate correctly and how to charm a date (look right at him and say: "Oh my, what nice eyes you have"). To avoid getting dirt under their fingernails when sliding on the base paths, they were told to scratch a bar of soap before the game.

Charm school fit right in with the league's so-called femininity concept. It produced a lot of good publicity but it was also a big pain in the neck—or knee, or calf. "It wasn't easy to walk around in high heels with a book on your head when you had a charley horse," remembers Lavone (Pepper) Paire Davis, who played shortstop and catcher for three teams and is now enjoying retirement in Van Nuys, California.

At the end of that first training camp, Wrigley's four managers selected the 60 best players and divided them up, as equally as possible, into four teams. Then it was time to "play ball." The players were paid between $65 and $125 a week. The 108-game "split" season lasted for three months, with the winner of the first half playing the winner of the second half in a championship series at the end.

*The slugger who became a nun*

That premiere season had barely gotten under way before a new generation and gender of baseball personalities began to shine. One of them was a statuesque redhead named Ann Harnett. She hit the ball well enough to finish as one of the league's best batters in 1943. Eventually the charismatic slugger became a nun and coached a boys' team at a Catholic school. One day, a former AAGPBL executive recalls, a nun dropped by and asked, "How're the boys upstairs?" She was referring, of course, to Wrigley and his associates.

For a decade, the AAGPBL teams—each consisting of 15 players, a manager, a chaperone and a driver—rattled around the heartland, trailblazing a path of equal opportunity where no women's professional sport had ever gone before. Everywhere they went, they won new fans—and kept them. "Maybe at first the men came out to see the legs," says Pepper Paire Davis. "But they stuck around when they realized they were seeing a darn good brand of baseball."

For managers, the league reached into the ranks of old-time ballplayers, many of whom came and went trailing faded dreams of glory. Bill Wambsganss of the Cleveland Indians, the only man ever to pull off an unassisted triple play in the World Series, always carried around a yellowed press clipping to prove it. Others, like the famous Red Sox slugger Jimmie Foxx, preserved their cherished memories in a bottle.

Chaperones protected the morals of the players at home as well as on the road. The girls were officially forbidden to drink, gamble, violate curfew, wear shorts or slacks in public, or go out on dates alone without permission and an interview of the prospective swain. A good thing, too. "My mother wouldn't let me play until I convinced her we'd be chaperoned," remembers Betty (Moe) Trezza of Brooklyn.

Quite a few of the girls were underage and the

Anna Mae O'Dowd of Chicago Colleens holds mirror, her teammate Beverly Hatzell Volkert fixes makeup.

Dorothy Schroeder, all-star shortstop who played 12 years in the league, scoops one up for photographer.

league kept a particularly close eye on them. Thelma (Tiby) Eisen, who was an outfielder with three different teams between 1944 and 1952, had an admirer when she was a rookie who followed her on a road trip. He checked into the same hotel one night and invited her up to his room before they went out to dinner. "I wasn't there three minutes before there was a knock at the door," Eisen says. "It was the house detective wanting to know what was going on."

Some chaperones knew their baseball; others did not. "We had one who was famous for yelling things like, 'Hit a home run, honey, and we win!' " Sophie Kurys recalls. "The only trouble was, we would be four runs behind in the bottom of the ninth with two out and the bases empty." Some chaperones had other priorities. Shirley Jameson of Albuquerque remembers going to bat in a tense situation only to be restrained by her chaperone. "Oh, my dear," the woman exclaimed. "You don't have your *lipstick* on!"

Off the field, chaperones sometimes had their work cut out for them. Maddy English, a third baseman for the Racine Belles who now lives in Everett, Massachusetts, once told a sportswriter who wouldn't stop pestering her: "If you don't leave me alone, I'm going to jump in Lake Michigan." He didn't. She did, and had to be fished out. Other infatuations were less threatening. Sophie Kurys had a fan club of 11- and 12-year-old boys in Racine, one of whom invited her home for a porkchop dinner one afternoon before a game. Faye Dancer, an exuberant center fielder for the Fort Wayne Daisies who now resides in Santa Monica, California, got a letter from a G.I. in France after her picture appeared in *Life* magazine. "I am not proposing," he wrote, "but I have about $1,000 and an old jalopy in New Jersey, I am footloose and fancy free, and I can settle anyplace."

Rockford Peaches chaperone Dottie Green attends to a "strawberry" on leg of player Lois Florreich.

*Dolly got beaned behind the ear*

On the field, there were times when the Girls of Summer could have used some protection from one another. Action was replete with daring plays along the base paths, brushbacks at the plate and painful "strawberries" from sliding hard in short skirts. One day Dolly Pearson Tesseine was playing shortstop for the Daisies when the opposing pitcher came barreling into second base and spiked her. "Next time you do that, I'm gonna jam the ball down your throat," Dolly said. When Dolly came up to bat, the pitcher knocked her down instead. Nobody got hurt that time, but when Dolly was batting in an exhibition game one day, she was hit right behind the ear by a pitch.

The players acted like women on and off the field. Pretty June Peppas of the Kalamazoo (formerly Muskegon) Lassies performed a little shimmy when batting that her fans called the "Peppas wiggle." But sometimes in the heat of a game the girls played just as recklessly as men. Once Alma (Ziggy) Ziegler of the Grand Rapids Chicks was playing second base when the batter hit a ground ball to the shortstop with a runner on first. The shortstop tossed the ball to Ziggy for a force-out at second and Ziggy threw to first for the double play. The runner, however, came into second base standing instead of sliding; the ball smacked into her and she was called out for interference. "I didn't throw at her," Ziggy recalls innocently. "She ran into the ball."

So intense was the play, sometimes even the umpires weren't safe out there. Pepper Paire Davis will never forget the time she knocked down Lou Rymkus, a hulking future all-pro football player who was moonlighting as an umpire. After sliding in at second, she whirled around to protest Rymkus' call and her fist inadvertently caught him square on the chin. The big guy ended up flat on his back. "I guess you know, Pepper," Rymkus murmured apologetically as he looked up at her, "that I gotta throw you out." Pepper knew.

In the scant free time they had to themselves, the players managed to raise a little hell every now and

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Nelda Bird and Pepper Paire Davis belt out the league song in 1947: "We're all for one and one for all . . ."

then. Joanne Winter got together with a teammate one night and tried to pass off two ladies of the evening on their manager as the new rookies he was expecting. Pepper Paire Davis and Faye Dancer occasionally hoisted a few beers together in a local cemetery to escape the prying eyes of townspeople, who tended to regard the players as kid sisters. "We *were* just kids having fun," recalls Dottie Collins of Fort Wayne, Indiana. "Not until it was all over did we look back and realize we had been pioneers."

It is clear, too, that ultimately they played with great skill and polish. After watching shortstop Dorothy Schroeder of Sadorus, Illinois, work out one day, Cubs manager Charlie Grimm said, "If she was a boy, I'd give $50,000 for her." Wally Pipp, one of the best glovemen in the business when he played first base for the New York Yankees in the early 1920s, called Dorothy Kamenshek of Anaheim, California, "the fanciest fielding first baseman I've ever seen—man or woman." Fort Lauderdale of the Florida International Baseball League once tried to buy her contract from the AAGPBL. Not long ago, after watching rare film footage of the league at its peak, a member of the Society for American Baseball Research enthused, "The way they were throwing the ball was unbelievable. It looked as though they were as good as men."

They weren't quite. They lacked the requisite power. No one in the league ever hit more than 16 home runs (though, granted, the fences in most ballparks were never moved in). But some old-timers remember seeing Triple-A players take practice cuts at the plate against the likes of Jean Faut Eastman (who posted 140 wins in eight years with the South Bend Blue Sox and had a combined earned run average of 1.23) and come up empty.

*Casey's mother played center field*

The league's second year, 1944, was the last for Wrigley and Sells, since it became obvious the war wasn't going to close down the majors after all. Wrigley sold his interest to Art Meyerhoff, his Chicago advertising man, and gradually ownership passed on to local boards in each town. Franchises at first flourished but then attendance sputtered fitfully until after the Korean War, when televised big-league baseball finally killed the AAGPBL forever. Whereupon the players, most still in their athletic prime, put down their bats and balls and gloves, and went on to raise families and often to coach their children. (It has been said of Helen Callaghan St. Aubin's son, Casey Candaele of the Houston Astros, that he "runs just like his mother." That's a compliment. His mother played center field for the Daisies.) They also started energetic careers in everything from pro golf, pro bowling and schoolteaching, to anesthesiology and statistical analysis.

The game seemed forever behind them. To most people they met, in fact, it was as if such a thing as women's baseball could never exist. When the subject came up, as Pepper Paire Davis told *Sports Heritage* magazine in 1987, "They'd do a doubletake and say, 'You mean softball.' And I'd say again, 'No, I mean baseball.' And after I'd say it about the fourth or fifth time, they'd say, 'You mean . . . *baseball*? Like *men's* baseball? Like with a hardball?' And from the look in their eyes, I could see that they still didn't believe me. You can look 'em right in the eye and say 'baseball,' and they'll look you right back and say 'softball.' "

Not until 1982 did persistent letter writing and spur-of-the-moment phone calls result in the league's first official reunion in Chicago. A second followed four years later in Fort Wayne, where, after a chorus of "The Old Gray Mare," the Fort Wayne Daisies' veterans defeated the Michigan-Illinois-Wisconsin team 8-3 in four innings. About that same time, the more active members of the league launched a letter-writing campaign aimed at persuading the curators at Cooperstown to develop a special exhibit recognizing their contributions to baseball. The players association organized in 1987 and then came a third reunion last year in Scottsdale, complete with the kind of high jinks the

Girls of Summer were famous for—shorting sheets, shave-creaming cars, coating light bulbs with Limburger cheese, filling Oreo cookies with toothpaste and posting a teammate's phone extension on the motel bulletin board under "Room Service—All Hours."

Out of all the comradery emerged a serious sense of purpose about making the Baseball Hall of Fame, a dream that was realized last fall. Now some league supporters have their sights set on a commemorative postage stamp. But more than that, as life's bottom of the ninth approaches, many want somehow to pass their overflowing goodwill and shared remembrances on to another generation of women athletes—athletes like Julie Croteau, for example, a freshman who started at first base this past spring on the men's varsity baseball team at St. Mary's College, a liberal arts school in Maryland. This summer she's sharpening her skills as a member of a semiprofessional team. "If there was a women's league today," she says, "I'm sure I'd be in it. But it's hard for me to think of playing baseball with girls. I've been playing with men all my life."

The "Women in Baseball" exhibition at Cooperstown seems to suggest that immortality in sports need not be limited to the newspaper clippings of a Bill Wambsganss. Or even to the poignant newsletter wish list crafted one recent Christmas by Pepper Paire Davis. With the same verve she once employed protesting close calls at home plate, Davis wrote:

> Give us the lust back,
> In the loving and the living.
> And the joy back
> In the sharing and the giving!
> Put the glow back in our face,
> That shows we enjoyed the race.
> The laughter back in our hearts,
> The youth and the strength,
> Till death do us part!

No one ever wins that kind of appeal in an argument with the ump, of course. But as every ballplayer knows, if you raise enough hell this time, the next decision just might go your way.

Retired from her post-baseball job in electronics, Davis plays catch at a park near her California home. Her career batting average was only .225 but Davis' sense of humor endeared her to players and fans alike.

*By Bruce Fellman*

# An engineer's eye helps biologists understand nature

*Holes in sea urchins and bones are round like the portholes in ships for the same reason, one that till now wasn't taught in biology class*

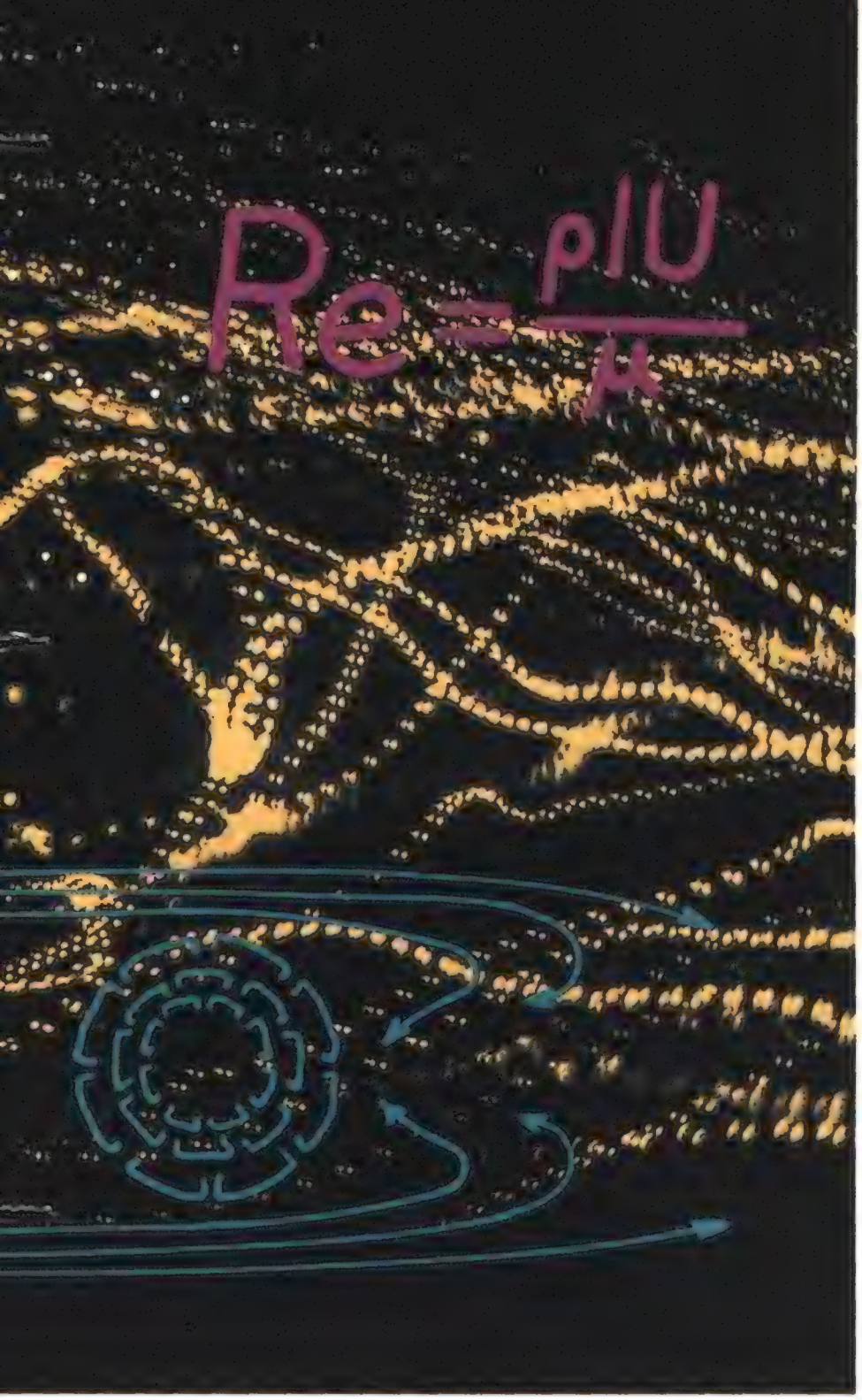
"I think that I shall never see, a perambulatory tree . . ." Cornell University botanist Karl Niklas, with no apologies to Joyce Kilmer, laughs at the rhyme. "A walking tree is an impossible organism," he says. "The energy necessary to create motion in a structure as big as a tree exceeds its ability to trap sunlight and convert it into energy."

Nature cannot violate physical laws. Delights such as walking trees or winged horses are just not possible, no matter how much we might like them to exist. But the natural world does take advantage of those same physical laws and appropriates them for its own uses in surprising and, until quite recently, underappreciated ways. The discoveries of an emerging scientific discipline called comparative biomechanics have shown that nature has a better imagination than any fantasy writer—and many biologists. The central insight is how the design and construction of plants and animals reflect the opportunities as well as the constraints of physics. Comparative biomechanics is the study of kangaroo hopping, the fluid dynamics of seawater around limpets, the catching mechanisms of spiderwebs, the stretchiness of seaweeds, the reason trees don't fall down and bones hold us up, and why a tetrakaidecahedron (a 14-sided polyhedron) is the best shape for the storage cells of plants, to mention just a handful of research projects in this wide-ranging merger of biology and engineering.

Consider the pinecone. For the past 200 million years, this intricate, scaly creation has sat out on a limb and dumped or received pollen, depending on the sex of the cone. The standard textbook line on female cones is that they are catcher's mitts, haphazardly snagging whatever pollen happens to be on the breezes.

But when Niklas looked at a pinecone, he saw a very different kind of structure. "Anything that's wind pollinated is subject to the same laws of aerodynamics as a plane fuselage or the flapping of a seagull's wings," he explains. "But no one had ever looked at it that way."

To determine how a pinecone *really* works, Niklas used a wind tunnel. After working first with a scale-model papier-mâché cone and helium bubbles to show the currents on which pollen traveled, he turned to real cones and pollen, photographing the patterns of currents the pollen wove around the cone. Here was no baseball glove, succeeding by simply being in the way. Rather, what Niklas observed was a coniferous air-traffic controller deliberately bending the flight paths of the pollen grains to its aerodynamic will.



Cornell botanist Karl Niklas studies fluid mechanics of wind pollination in living and prehistoric plants.

A papier-mâché scale model of a pinecone stands in a wind tunnel as helium bubbles reveal how its shape affects the air currents moving past. The design of a cone creates eddies that bring pollen grains curving around and into the scales where they will fertilize the waiting ovules. Superimposed diagram at lower right shows idealized tracks of windborne particles. The formula relates scale of the model to real-life sizes.

The pollen grains flew over the top of the cone, and once on the lee side, a secondary, corkscrew current carried the fliers in a spiral around the scales. These set up eddy currents of their own that swept the pollen between the scales where it would eventually complete fertilization.

"I see the cone as a turbine that can't rotate on its axis," says Niklas. "Instead, this collection of little airfoils—wings, if you will—causes the air to rotate around it."

This explanation seems intuitively obvious. So why was the obvious missed for so long?

"Biologists don't know the everyday, practical kind of physics. They may know what a quark is, but it's more important that they know how to build a bridge," declares Steven Vogel of Duke University in Durham, North Carolina.

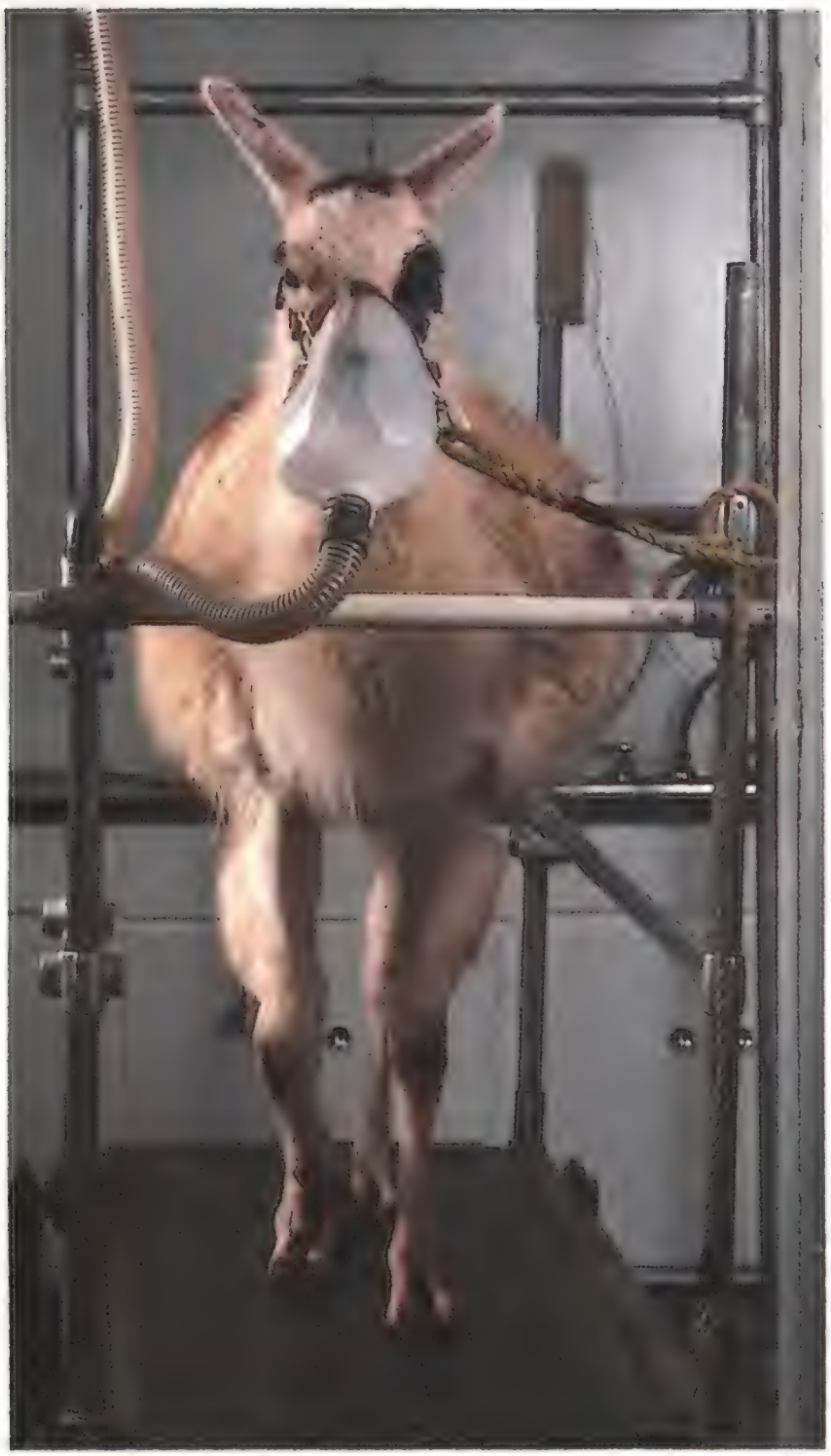
Vogel is one half—the other is Duke colleague Stephen Wainwright—of this country's prime moving force in biological (as opposed to orthopedic) biomechanics. The two are singularly responsible for pushing principles of mechanical engineering into the mainstream of biological thought.

Of course, a *working* knowledge of biomechanics long predates Vogel and Wainwright. As they readily admit, the earliest human technologies were based on a practical understanding of plant and animal engineering. Roman weapons designers scored a very large coup when they came up with the ballista, a fearsome device that could hurl a 90-pound stone one-quarter of a mile. The ICBM of its day stored energy by twisting a bundle of animal tendons. When these twisted tendons unwound, it was "Bombs away!"

One of the earliest written considerations of biomechanics comes from Galileo Galilei, the Italian astronomer best known for his cosmological heresies. In myth, fairy tale and science fiction, creatures from beanstalks to capillary-cruising submariners are for-

*Photographs by Peter Angelo Simon and Ian Christie*

*Mechanics comes to biology labs*



A llama works out on a treadmill at Richard Taylor's Harvard field laboratory in study of muscle forces.

ever changing size, but more than 300 years ago Galileo demonstrated, in his treatise *Two New Sciences*, a clear feel for the consequences and limitations of the changes.

"Thus it is impossible to build enormous ships, palaces, or temples, for which oars, masts, beamwork, iron chains, and in sum all parts shall hold together; nor could nature make trees of immeasurable size, because their branches would eventually fail of their own weight . . ." he wrote. Galileo knew that for every alteration, for every decrease and increase, there were biological and engineering implications. But what were the rules of the game?

*Biomechanics and the mystery of life*

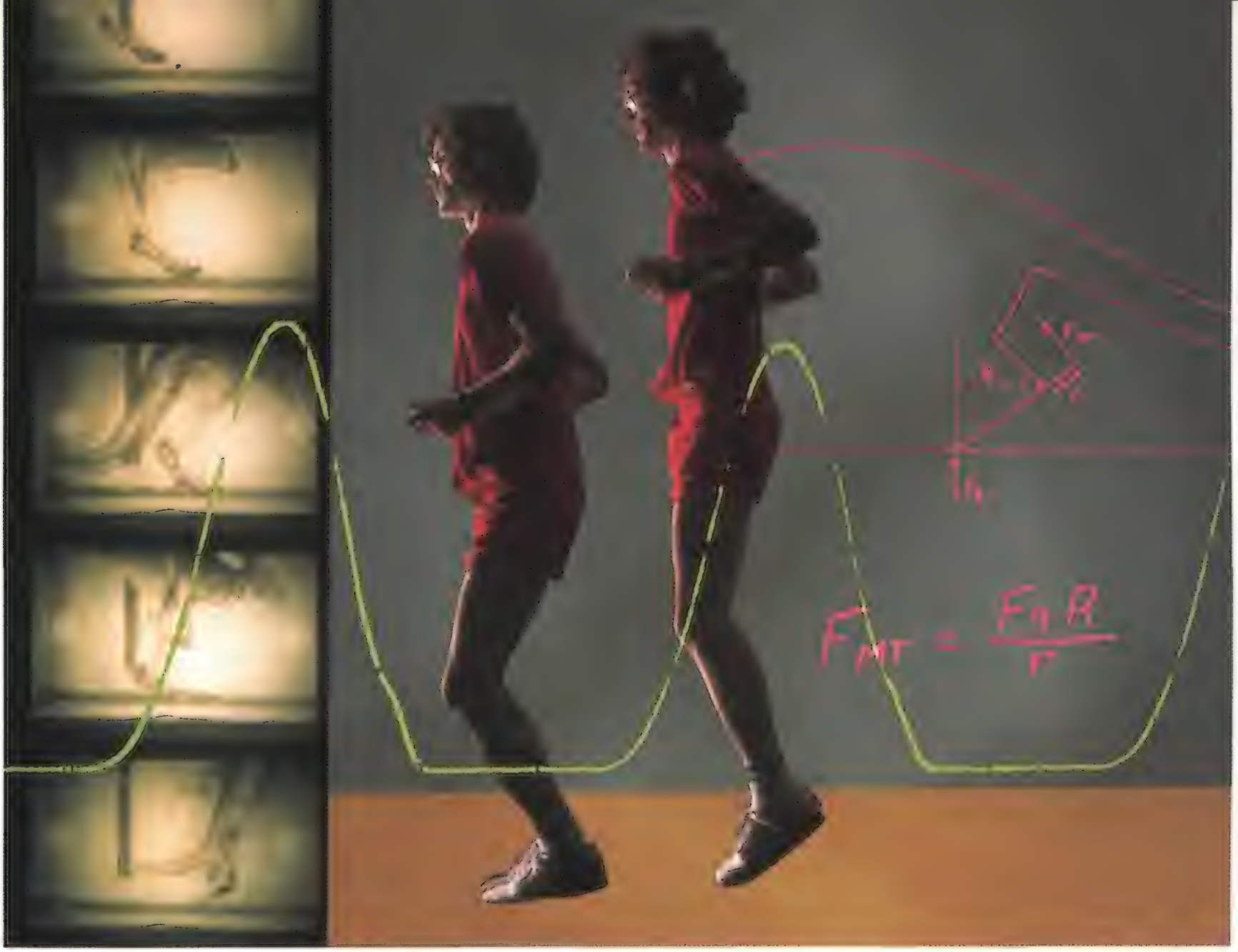
The best, and certainly the most exhaustive, exploration of this question can be found in D'Arcy Wentworth Thompson's classic book, *On Growth and Form*. First published in 1917 and still in print, the exquisitely written and illustrated volume is responsible for many seductions into the biomechanics field. The Scottish biologist exhorts his readers (and assails those disinclined to follow) to "explain by geometry or by mechanics the things which have their part in the mystery of life."

But Thompson never trained a cadre of students. The task of channeling the enthusiasm generated by the book fell to a Cambridge professor, Sir James Gray. As a researcher, Gray was fascinated by how animals move, and his 1968 book, *Animal Locomotion*, remains a standard reference on the subject. He was also a diligent teacher and an employment counselor, as well as the organizer and editor of the discipline's preeminent publication, the *Journal of Experimental Biology*. In essence, Gray engineered the field.

"Of course, what we do is the reverse of the engineer's approach," says Vogel. "An engineer says, 'I want to do the following, what's the best design I can come up with?' We say, 'Given this design, what was it designed to do?' We've got the answer—the organism—and we have to figure out the problem."

A biologist's traditional education is not much help in framing the right questions. "There's nothing in a basic physics course that would teach you why, for example, the portholes on a ship or a plane should be round," Vogel notes. "And if you don't know that, you can't appreciate the skeletons of echinoderms that have all kinds of little round perforations, or the shapes of holes in bones. These, to the best of our knowledge today, are the best designs to minimize crack propagation—and that's engineering."

Seeing the natural world from an engineer's viewpoint has enabled biologists to explain the unexplainable. Take the case of the seemingly suicidal




The forces developed in the muscles and tendons of a kangaroo, in strip at left, and those of a more familiar runner are governed by the same formula. Green line is an oscilloscope trace measuring the impact when researcher Rodger Kram lands—storing energy in his tendons for any subsequent launch.

coquina clam. These brightly colored, fingernail-size mollusks live in wet sand, just below the surface, and they're common on wave-swept beaches throughout the warmer parts of the world. In 1983, they made quite an impression on Olaf Ellers, who had just come to Duke as a graduate student of Vogel's. The soft-spoken biologist, now a professor at the University of California, Davis, had taken his parents sightseeing to the North Carolina coast, and as they watched the breakers rolling in and out, Ellers noticed something very strange. "There were little clams jumping out of the sand," he says. "It was a really dramatic thing. You'd look out at the beach, and there'd be no animals on it at all. Then a wave would come in, and all of a sudden, the sand would be paved with clams. This wasn't anything I remembered hearing about in invertebrate zoology class."

Mollusks leaping into the surf: to Ellers, such behavior seemed, well, stupid. At first he thought the clams came out of the sand so that the waves would carry them from one place to another, the wave power harnessed for their own locomotion. But, he wondered, would not the outwash carry them out to sea?

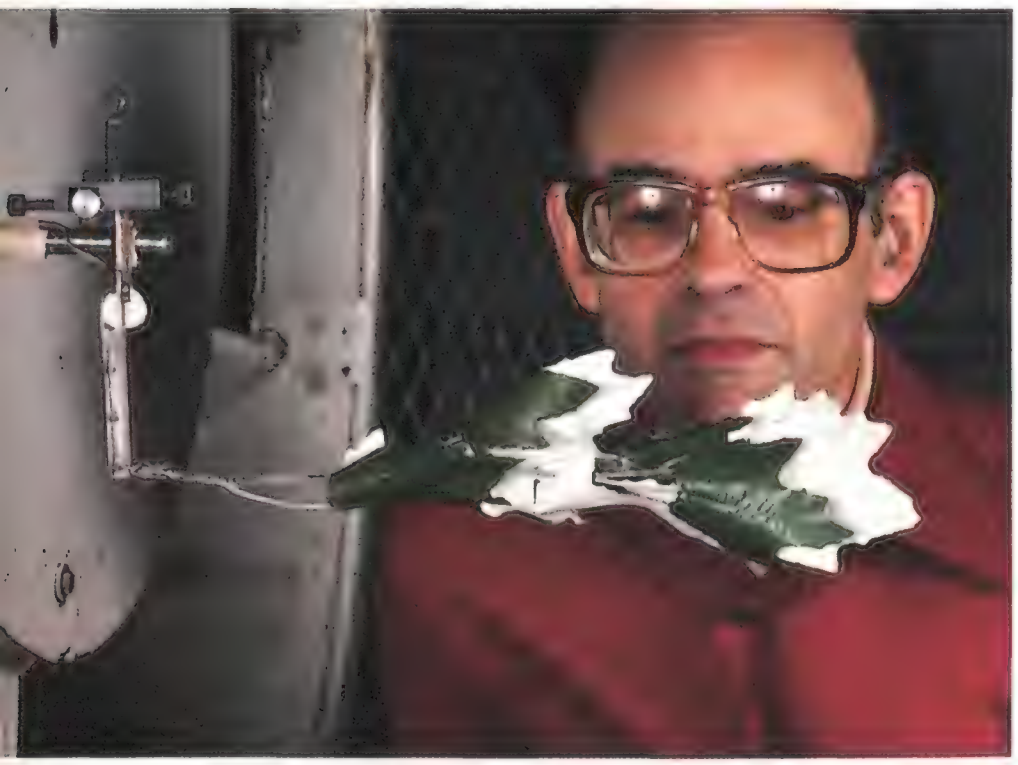
"I like to think of animals as being 'clever'," says Ellers, and when he put the coquinas in a flow tank that mimicked the surf, he learned just how clever they were. There is, however, no molluscan "intelligence" involved. The clam's ability to avoid being washed away lies almost entirely in its shape.

Coquinas are built along the lines of wood splitter's wedges, and because of this unusual (for a clam) shape and density, these mollusks are not at the mercy of the waves. When they make what seems to be a fatal leap from the sand into the surf, the water washing over them automatically reorients them with their thin end facing upstream. There they can briefly remain—suspended as if by wires—until the wave subsides, and the clam drops anchor with its foot and burrows back under the sand.

The interaction between the current and the ani-

*Bruce Fellman is working on a book on experimental ecology in temporary ponds. He last wrote for* SMITHSONIAN *on combustion research (October 1987).*

Stephen Wainwright of Duke shows how helically wound fibers permit cylinder to bend without kinking.



Steven Vogel, also of Duke, watches leaves fold over one another in strong wind, lowering their resistance.

mal's design sets up what Vogel terms "flow-induced pressures." The notion that flow patterns around objects can cause subtle and not-so-subtle variations in pressure is old hat to engineers. Indeed, Swiss mathematician Daniel Bernoulli mapped out the concept in 1738, and the Bernoulli Principle is the foundation of aviation. An airplane flies because the shape of its wings creates more pressure below them than above them. Without that lift, a flight remains grounded.

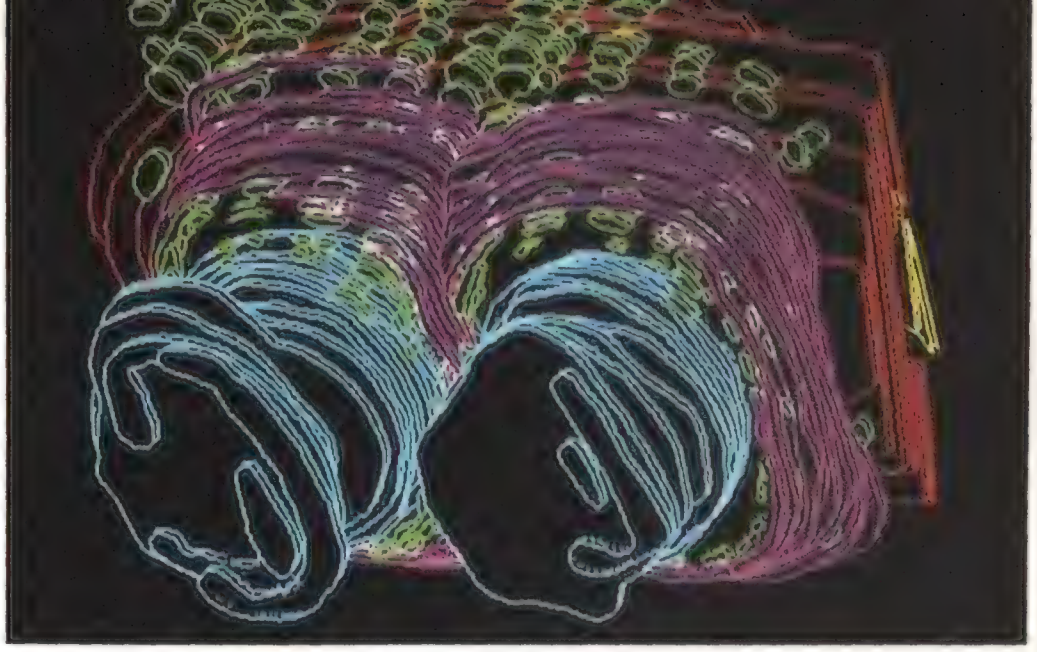
*Getting into flow with fruit flies*

The tricks plants and animals might play with pressure variations have interested Vogel since his student days in the 1950s and '60s. "I got into the flow business when I started looking at how insects control their wing beats," he explains. "I was trying to fly fruit flies in a wind tunnel. It sounds preposterous, but it's not as ridiculous as you think. You learn how to solder little wires onto the miserable insects."

For his efforts, the brash biologist demonstrated that the physics of air moving over the wings was as important to drosophila as it was to a 747. The branch of science that describes this kind of physical behavior is called fluid mechanics, and it is not for the faint-hearted. When applied to airplanes, fluid mechanics involves hairy mathematics, and still the results must be tested in wind tunnels. When applied to the infinitely variable world of animals, however, the mathematics is not powerful enough to give answers. Vogel found he nevertheless could get the answers he wanted by going directly to the wind tunnel. The work has opened up a new way of seeing the world.

As an example of how fluid mechanics can help the observer appreciate natural design, consider a fast-swimming, streamlined fish. "The mouth is at the point of highest pressure so the water goes in," Vogel explains. "The gill covers are located at the point of lowest pressure, so the water is forced out. Wherever pressure is positive—that's inward—you have a bony skull so the fish won't collapse, and where the pressure is outward and negative, you have a tension-resisting skin. The eyes of the fish are located precisely where pressure goes from positive to negative, so the focus of the eye won't change with swimming speed. The whole damned fish is beautifully designed to make these pressure distributions work for it rather than against it."

At least some creatures are able to tap into the pressure fields that are created by wind and water currents flowing around their bodies. They can then take advantage of the Bernoulli Principle to perform a variety of tasks. The squid, for instance, uses flow-induced pressures to assist its jet propulsion. The way Vogel went about demonstrating this is typical of his approach to biology. "I don't especially like animals—



Thin sections cut through suckers on octopus tentacle reveal how the different muscle groups play off against one another.

William Kier, of University of North Carolina, studies how octopus tentacles can be strong and bend at any point, in any direction.

they bite me," he quips, at least half-serious. "So I made them on a lathe. It's just as well."

When these streamlined, aluminum squid were monitored in a wind tunnel under conditions that approximated swimming, Vogel discovered that squid have Bernoulli on their side. Forward movement reduces the pressure alongside a squid's body, and this pressure reduction makes it easier for the animal to fill up with the water that will be squeezed out its downstream end to shoot it ahead. The faster it swims, the faster it fills.

Vogel and his students have documented many other Bernoulli Principle profiteers. Sponges use flow-induced pressures as a "low-cost" way of pumping water through their bodies. Scallops rely on pressure fields to help reopen their flapping shells. The great baleen whales are aided by water pressure in expanding their massive throat pouches.

Bernoulli also figures into Steve Wainwright's work, but not as directly. When the Wright brothers took off from Kitty Hawk, the specially modified bicycle chain that linked propeller to engine came from the Wainwright family's factory in Indianapolis. Engineering was in his blood, but so was art, sculpture in particular.

Biomechanics provided him with a way to combine these endeavors. "I look at the various structures that exist, and I try to figure out what they're there for," Wainwright explains. For example, he and his student Lisa Orton showed that whale blubber is more than mere fat. "It's a highly complex material that's actually part of the whale's motor," he says. To be sure, blubber is insulation, but the fatty material is also interlaced with a network of tendons. Like rubber bands, these absorb and release energy as the whale swims. "Roughly 20 percent of the power in the swimming stroke comes from the elastic energy stored in the blubber."

Wainwright is perhaps best known for the work he's done on the helically wound fiber systems that seem to pervade the natural world. The helix, Wainwright believes, is a key to understanding how life evolved beyond a population of essentially two-dimensional creatures. "Even today, there are some very successful sheetlike organisms, like sea lettuce. And if that's all there was, eventually the whole world would be covered by a mat," he says.

But anything that could grow up or down would have all this new territory to exploit. Of course, the organism would also have to deal with gravity and a number of other physical forces that limit possible body plans. The more the sculptor looked at the shapes nature had crafted, the more he realized that they were based on cylinders. However, a simple long, thin balloon would not do the trick.

To demonstrate why, Wainwright reaches into his desk and pulls out a package of balloons. He blows into one, enough to make it fill out but not enough to expand any of the material. He blows again, and now a bulge appears, a kind of aneurysm. Of course, aneurysms are counterproductive, since they have an annoying habit of bursting. Fortunately for the evolution of life on Earth, these bulging instabilities are easily corrected. Wrap the cylinder with a couple of sets of fibers, and organisms can become three-dimensional.

As I watch, Wainwright gleefully demonstrates how well this solution works by clothing the balloon in a sheath made from one of those red-and-white checkered tablecloths found in Italian restaurants. "Sure enough, this solves the aneurysm problem, but it's a terrible worm. When you bend it, it kinks," he continues. Such a creature, made with a sheet of longitudinal fibers wound over a sheet of circumferential fibers, would also have trouble moving.

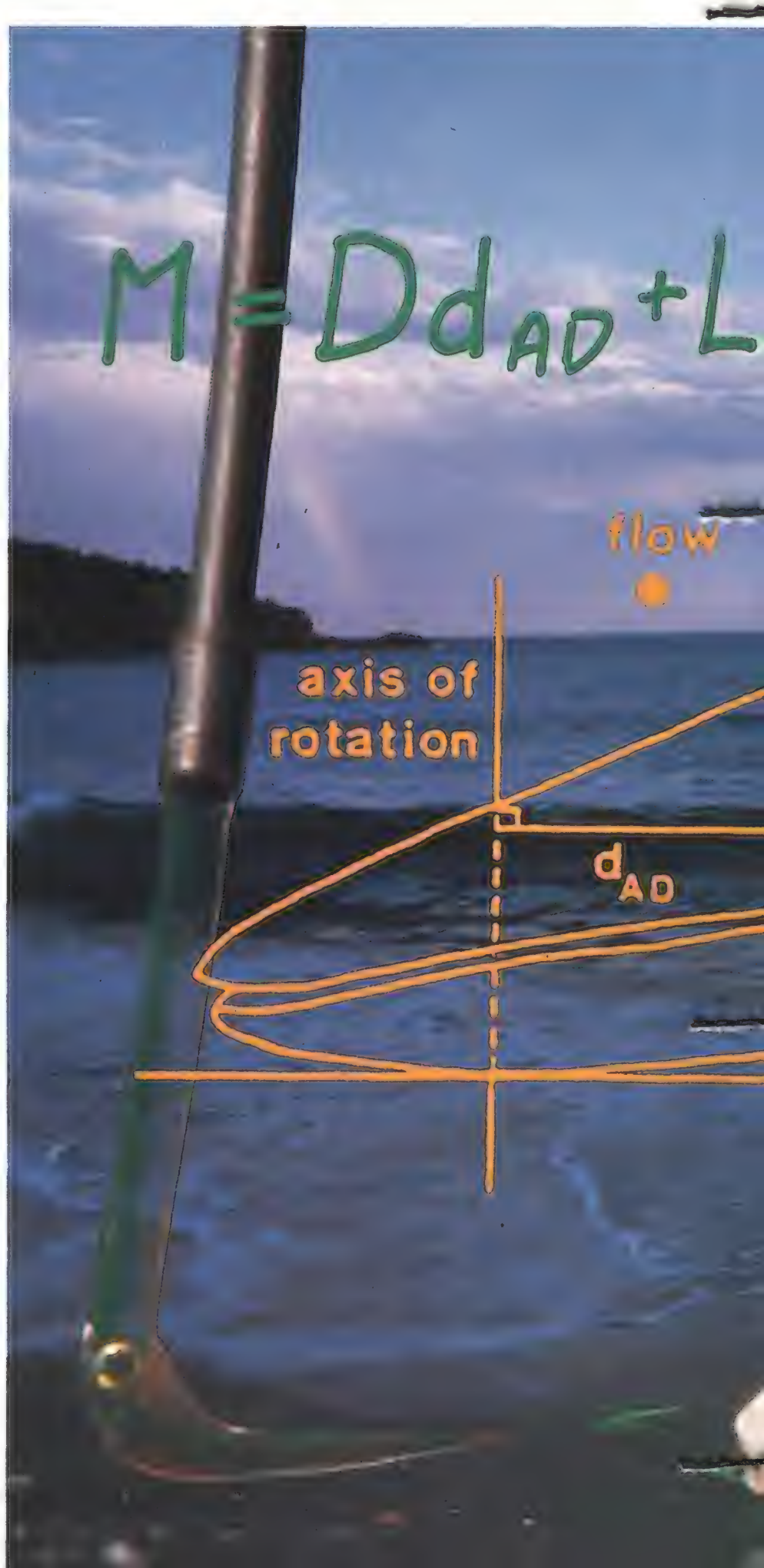
The way around this is to cut the tablecloth on the bias, like a necktie. "It gives you a cross-helically wound pattern that allows bending without kinking, which in turn allows movement."

Here was Wainwright's organizing principle. He and his students have found it at work throughout the plant and animal kingdoms, in organisms as diverse as palm trees and octopuses.

William Kier, a biologist at the University of North Carolina, and his wife, Duke University anatomist Kathleen Smith, have figured out the modus operandi of lizard tongues, elephant trunks and octopus tentacles. All, it seems, depend on muscles—including muscles that are helically wrapped around the limb or organ. These structures are alike in that they lack visible means of support. Most organisms depend on skeletons that are internal (mammals) or external (beetles and Dungeness crabs, for example). Others, such as worms and sea anemones, use "hydrostatic" skeletons in which connective tissue surrounds a cavity filled with liquid. The liquid is incompressible; when muscles tighten around it, the organism is supported.

The legs and arms of some animals, however, don't appear to use either system. Kier was particularly puzzled by the tentacles of octopuses and squid: "If you've ever eaten them, you know that when you saw across the tentacles with a knife, they're solid muscle." Muscles have to pull on something, normally a skeleton of some sort. There are no bones in a tentacle, and no fluid-filled cavities to compress. Kier and Smith have found that such body parts work as *muscular* hydrostats, in which muscle itself takes the place of the fluid. A squid, for example, can play one group of muscles in a tentacle off against another. Contracting one group while keeping another stiff (so that in effect they act like bone) allows the limb to bend. And because there are no joints, the tentacle can bend at any point and in any direction.

The dossier compiled by biomechanists is full of similar examples of elegant design that required an observer with a different perspective, not to mention a healthy dose of engineering, to become obvious. Now chicks carry weighted backpacks and run while wearing strain gauges on their legs to determine the impact of stress on bones. Labrador retrievers, horses, kangaroo rats and humans jog on a device called a force plate to help scientists understand muscle use. There are swingers of oaks, horsetails and birches who are searching for the elastic similarities among plants. Researchers peer through microscopes to learn the mechanics of helical swimming among microorganisms

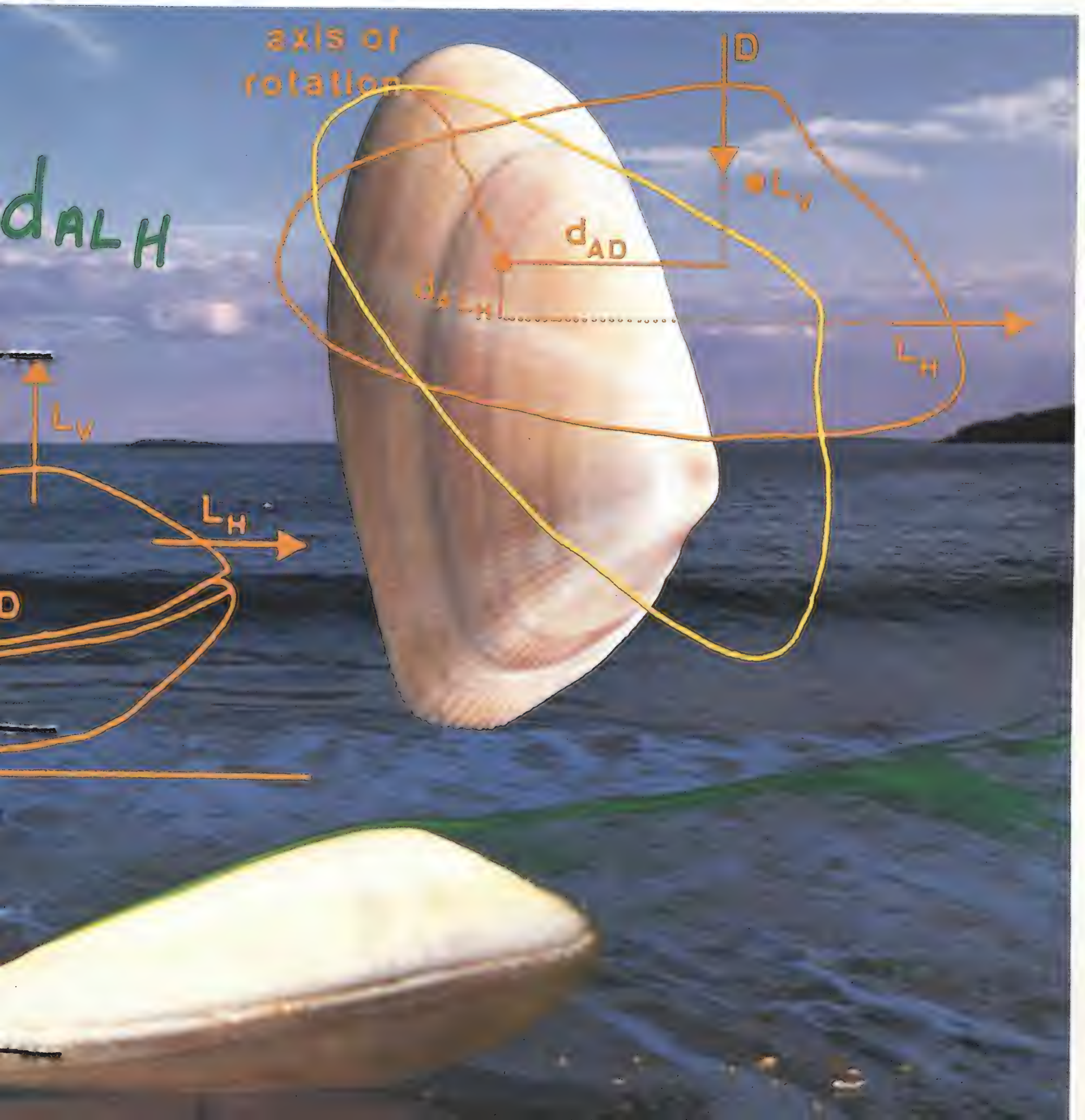



Photomontage shows how the design of coquina clams affects their movement and orientation in receding surf. In a flow tank, green tracing fluid released upstream of clam (bottom) reveals how wedge shape affects flow. Equation indicates that, at a certain strength, the flow rotates clam (right—top view) and at the same time creates pressure that lifts up on the clam's blunt end (left—side view). The clam turns like a weather vane in wind. Once the shell is oriented with flow, the pressure changes, pushing pointy end to sand so clam can quickly extend foot and dig down.

and prey capture by copepod arms. Paleontologists take the engineering approach to figure out how fossils lived and developed.

Don't assume, however, that the underlying goal of comparative biomechanics is to demonstrate a kind of perfection in nature. "I don't like to use the word 'optimum,' " Vogel admits, "for there may be a better solution that an organism hasn't discovered, or can't easily discover. We make the assumption that if a plant or an animal is here, it must be doing something right. If it looks badly tuned, it's a clue that the observer is just barking up the wrong tree. It may be doing things that are laughably crude, but remember, natural selection is not perfect. It can't try every possibility. It hasn't had unlimited time."

And time, as Woody Allen, surely the most unlikely of evolutionary theorists, noted, is "nature's way of preventing everything from happening at once." In the world of natural engineering there can be neither walking forests nor gridlock.



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*By Cassandra Tate*

# In the 1800s, antismoking was a burning issue

*The 'foul narcotic' was to blame for baldness, insanity, tooth decay and other ills*

A century ago, Congress was asked to require that "coffin nails" be stamped with a skull and crossbones and marked "Poison."

It was a typical morning on the road for W. D. (Big Bill) Haywood; typical in that he was in a saloon, but untypical in that he was about to be arrested for possessing a cigarette. As a radical union leader during the most turbulent years in American labor history, Haywood was accustomed to legal difficulties, usually related to his activities on behalf of the Industrial Workers of the World (Wobblies). He tangled with the law in another way on the morning of June 16, 1909, in the Mint Saloon in Ellensburg, Washington, when he rolled a cigarette, put it between his lips and prepared to light up. He was promptly nabbed by a deputy on charges of violating a state law prohibiting the sale, manufacture or possession of cigarettes. He attempted, to no avail, to get rid of the incriminating evidence by dropping it on the floor. After posting $15 bail, Haywood traveled on to nearby Yakima, went straightaway to the Hotel Yakima bar, took out his "makin's" and was arrested once again.

A week later, he was caught flagrante delicto in the town of Davenport. The charges in Ellensburg were dropped at the direction of the county prosecutor, who thought the law was unconstitutional, but Haywood was found guilty in the other cases. He paid a total of $9.50 in fines, plus $5.95 in court costs. "After all the indictments I had been subjected to, this was my first conviction," he wrote years later in his autobiography.

Haywood's record might have been further blackened had he ventured into any one of the nine other states that had similar laws on the books as of June 1909. In many ways, the antismoking movement of the 1980s is a model of restraint compared with one that began more than a century ago. Beginning with Washington in 1893, no fewer than 14 states outlawed the sale, manufacture, possession, advertising and/or use of cigarettes, aka

Woodcut of 1576 shows tobacco plant and earliest image of cigar, at right.

coffin nails, little white slavers, dope sticks, paper pills, brain capsules, coffin pills and devil's kindling wood. At least 21 other states and territories considered cigarette prohibition.

Congress was asked to protect the public health by requiring that cigarette packages be stamped with a skull and crossbones, and labeled "Poison." Many employers refused to hire cigarette smokers. Nonsmokers said their health was being jeopardized by "secondhand smoke." When U.S. Surgeon General C. Everett Koop declared in May 1988 that cigarettes were as addictive as cocaine and heroin, he was echoing sentiments that had been expressed more than a hundred years earlier. As the author of one antitobacco tract put it in 1877, "So powerful are the charms of this foul narcotic that health and long life are sacrificed to it by millions." The *New York Times* reflected prevailing attitudes when it editorialized in 1884 that the "decadence of Spain began when the Spaniards adopted cigarettes and if this pernicious practice obtains among adult Americans the ruin of the Republic is close at hand."

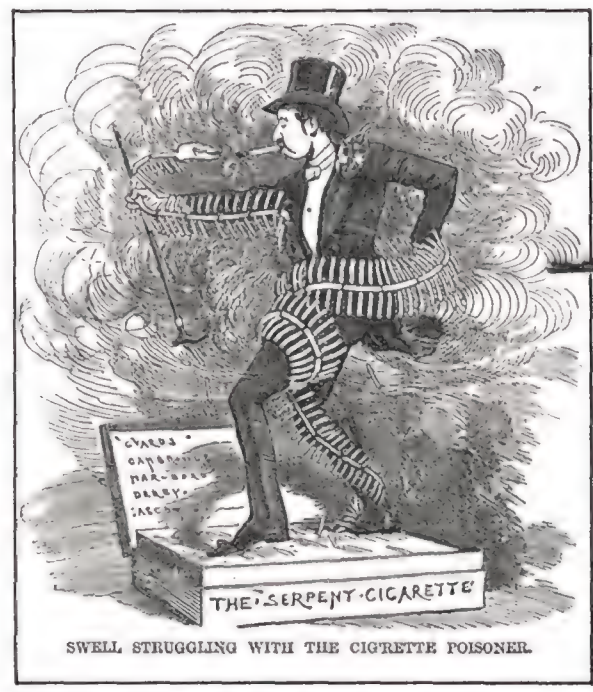
Life has never been easy on Tobacco Road. The state legislators who passed anticigarette laws in the late 19th and early 20th centuries were members of a large fraternity of kings, emperors, popes and potentates who have tried, at various times and in various ways, to wean their constituents from Lady Nicotine. The first recorded legal proceeding against a smoker was initiated on ecclesiastical grounds in the 15th century. When Rodrigo de Jerez, a member of Christopher Columbus' expedition who apparently learned to smoke in Cuba, lit up for the first time back home in Spain, the townspeople—alarmed by the smoke issuing from his mouth and nose—assumed he had been possessed by the devil. He was promptly imprisoned by the Inquisition. King James I considered tobacco and papism to be among the biggest evils facing his realm. Several popes agreed with him, at least on the first point. Pope Innocent X and Pope Urban VIII excommunicated smokers.

Excommunication was the least of a smoker's worries in the 17th century. In China, an imperial edict issued in 1638 made the use or distribution of tobacco a crime punishable by decapitation. Sultan Ahmed I of Turkey reportedly ordered the noses of smokers to be pierced with pipestems. His son and eventual successor, Murad IV, took an even harder line: he had smokers executed as infidels. In Russia, smokers were flogged; the nostrils of repeat offenders were slit; persistent violators were exiled to Siberia. In Persia, they were tortured, impaled and/or decapitated.

The first organized antitobacco movement in the United States began in the 1830s. It was supported largely by temperance workers, who argued that smoking dried out the mouth, creating a "morbid or diseased thirst" that could be satisfied only by the whiskey jug or the brandy bottle. The readers of one antitobacco tract were taken on a visit to the Realm of Satan, where Prime Minister Tobacco assisted King Alcohol in evil deeds.

The "sot weed" also attracted the attention of early health reformers. Sylvester Graham, whose name has been immortalized by the Graham cracker, included abstinence from tobacco and alcohol in his blueprint for health, as did advocates for such diverse medical dogmas as hydropathy, phrenology and eugenics. Joel Shew, a promoter of hydropathy ("the water cure"), counted 87 diseases caused by smoking, including cancer, heart disease, constipation, acne, insanity and tooth decay. Tobacco faced a lengthy list of other indictments. It was unnatural, unclean, unwholesome, unrefined, unattractive, ungentlemanly and messy. It caused baldness. It exhausted the soil. It was a waste of money. It fostered pauperism and crime and a "horrid train" of other social problems. It had "ruinous effects" on morality. Some reformers said that the moral decay sprang from physical deterioration; others that tobacco attacked the conscience directly. At any rate, it was agreed that smoking was associated with indolence, licentiousness, profanity and the reading of novels, among other signs of depravity.

Tobacco had its defenders, of course. The argument that it was an "accursed tributary" leading to drink was countered by the claim that it promoted temperance. Many writers,




Early antismoking tracts vividly portrayed the evils of smoking.

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Taking snuff was once chic for both men and women, though the short fellow in 1827 etching destroyed his nose by sniffing too much.

both physicians and laymen, recommended smoking for health. Belief in the healing power of tobacco dates back to the 16th century. Tobacco, unknown in the Old World, was widely distributed in the New. Since native Americans enjoyed uncommonly good health compared with Europeans at the time of contact, it seemed logical that they were being protected by something in their environment. An enthusiastic clan of physicians, sailors, scholars and quacks built a body of faith around tobacco, incorporating it in the treatment of an almost-inclusive list of health problems. Although the luster of tobacco as a panacea faded in the 18th century, it continued to be included in the materia medica until well into the 20th century. Many Victorian physicians believed that the heated smoke of a cigarette, pipe or cigar would kill germs. Both the popular and the scientific press carried periodic reports about the effectiveness of smoking as a disinfectant and prophylactic.

The antitobacco campaign lost its momentum during the mid-1850s, when the growing conflict over slavery overshadowed other social issues. With the outbreak of the Civil War, the crusade vanished almost entirely from public view. By the 1880s, however, antismoking forces had regrouped, in response to the threat posed by a new enemy: the cigarette.

Cigarettes of sorts date back to the Aztecs and the Maya, who smoked tobacco in hollow reeds, cornhusks, leaves or, less commonly, paper. A prototype was first seen by Europeans in Mexico in 1518. Crude cigarettes made from cigar butts and scrap tobacco were popular among the poor in 17th-century Spain. By the mid-19th century, tobacco shops in New York were carrying hand-rolled cigarettes for the carriage trade. Cigarettes were common enough by 1864 to be taxed for the first time. Still, they were slow to catch on. Tax records indicate that fewer than 20 million "ready-mades" were sold in 1865. Sales declined as tax rates rose during the next few years, bottoming out at 1.8 million in 1869.

The development of a workable cigarette manufacturing machine in 1881 was the Promethean spark that gave life to a new industry, and subsequently ignited a new antismoking movement. The machine, invented by a Virginian named James A. Bonsack, could produce 200 cigarettes a minute, for a total of 120,000 a day, equal to the output of 48 skilled laborers. Cigarette manufacturers initially resisted mechanization, fearing that the public would shun a machine-made product. The first to prove otherwise was James Buchanan Duke, who had taken over a tobacco company founded by his father in Durham, North Carolina, during the Civil War. Duke bought two Bonsack machines in 1884. Five years later, he was selling almost a billion cigarettes annually, far more than any other manufacturer. He then persuaded his four closest competitors to join him in organizing the American Tobacco Company, with himself as president. This combination, known as the Tobacco Trust, enjoyed an almost complete monopoly of the cigarette trade for more than 20 years.

Mechanization, the use of new domestic hybrids instead of imported tobaccos and substantial tax decreases greatly reduced the retail price of cigarettes. Typical domestic brands sold for a nickel for a box of ten in the 1880s; a decade later, the cheapest brands were priced at 20 for a nickel. Once a novelty for the adventurous upper class, cigarettes had returned to the poor man's milieu, where they increasingly attracted the attention of the reform-minded. The cigarette was a tempting target in part because it was relatively new, and thus less entrenched than the banker's cigar or the farmer's pipe. It was also faintly

*Cassandra Tate last wrote about the reviving art of whistling, in the February 1986* SMITHSONIAN.

subversive, a symbol of disturbing change, associated with cities and immigrants. New York City alone accounted for 25 percent of the cigarette sales between 1895 and 1910. Machine-made cigarettes were popular with immigrants. Expensive hand-rolled brands continued to be smoked by daring members of the upper classes. Middle-class reformers from the xenophobic hinterland tended to hold suspect the habits of the foreign-born, the wealthy and the citified.

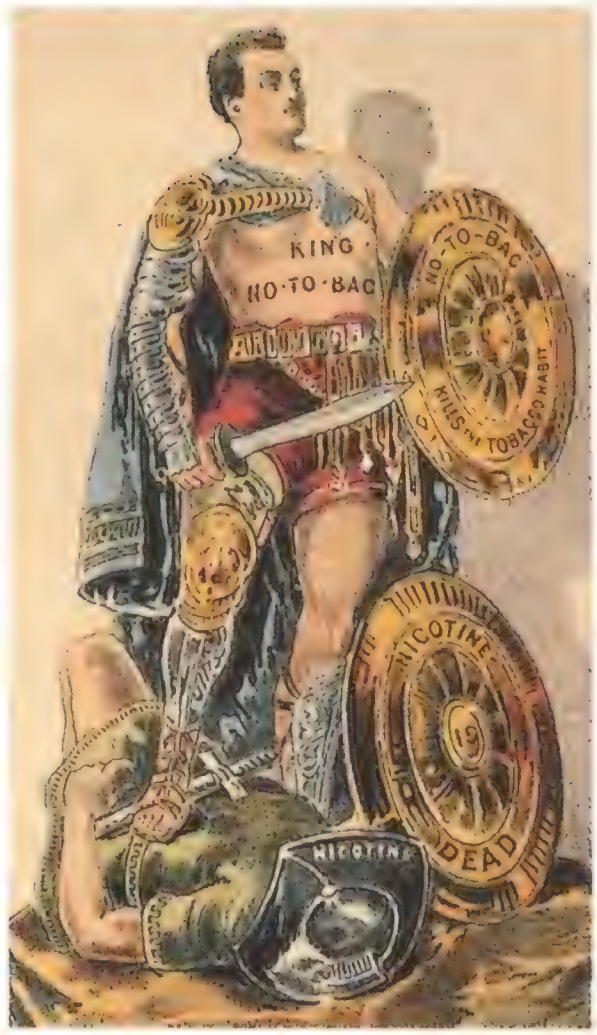
For whatever reason, many Americans were prepared to believe the worst about cigarettes. Both the reformist press and mainstream newspapers reported that cigarettes were spiked with opium and wrapped in paper that had been whitened with arsenic or poisonous white lead. The *New York Times* discounted the allegations as "gross exaggerations" in 1877, but ten years later took it as common knowledge that the "wrappers of some Turkish cigarettes are impregnated with opium. . . ."

The rumors persisted until after World War I despite a series of studies by prominent chemists, published in 1892, showing that cigarettes were free of opium and its derivatives, and contained no arsenic or related poisons. One chemist pointed out that it made little sense on the face of it to add expensive opium to cigarettes that sold for about half a cent each. Nonetheless, a U.S. Supreme Court Justice in a 1900 decision upholding a ban on sales in Tennessee remarked that "there are many [cigarettes] whose tobacco has been mixed with opium or some other drug, and whose wrapper has been saturated in a solution of arsenic."

James B. Duke's mechanized system spawned the giant tobacco industry.

Opium wasn't the worst of it. By some accounts, cigarette factory workers urinated on the tobacco to give it "bite." Turkish cigarettes were supposed to contain "clay, dirt, filth, germs, bacteria, expectorations, etc." Egyptian brands were even more vile, having been made with dried, crushed camel dung, flavored with hashish. Domestic brands might be made from the butt ends of cigars, fished out of spittoons and gutters by derelicts and urchins. An old allegation involving leprous cigars was dusted off and recycled as a report that hundreds of cases of leprosy in San Francisco had been traced to the smoking of cheap cigarettes made by Chinese lepers.

Although it is not possible to determine how much of this was believed by the general public, cigarettes clearly had an image problem in the years before World War I. Apart from the question of what was in them was the matter of who smoked them. Cigarettes represented "the apotheosis of insipidity," favored only by dudes and degenerates. The *New York World* could offer no greater insult to the young Theodore Roosevelt than to describe his followers as the sort who smoked cigarettes. Contemporary attitudes were summed up by John L. Sullivan, pugilist and social commentator: "Who smokes 'em? Dudes and college stiffs—fellows who'd be wiped out by a single jab or a quick undercut. It isn't natural to smoke cigarettes. An American ought to smoke cigars, an Englishman a briar, a Harp a clay pipe. . . . It's the Dutchmen, Italians, Russians, Turks and Egyptians who smoke cigarettes and they're no good anyhow."

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The case against cigarettes included the charge that they were unhealthy, even fatal. They were associated with heart disease, respiratory problems, birth defects and most of the other diseases now linked to smoking. The major exception was lung cancer, which was very rare until the 1930s, and not even recognized as a disease until 1923. The warnings about the hazards of smoking do not appear to have been taken very seriously, however, perhaps because they did not have the endorsement of the medical establishment. As late as 1948, the *Journal of the American Medical Association* was arguing that "more can be said in behalf of smoking as a form of escape from tension than against it . . . there does not seem to be any preponderance of evidence that would indicate the abolition of the use of tobacco as a substance contrary to the public health."

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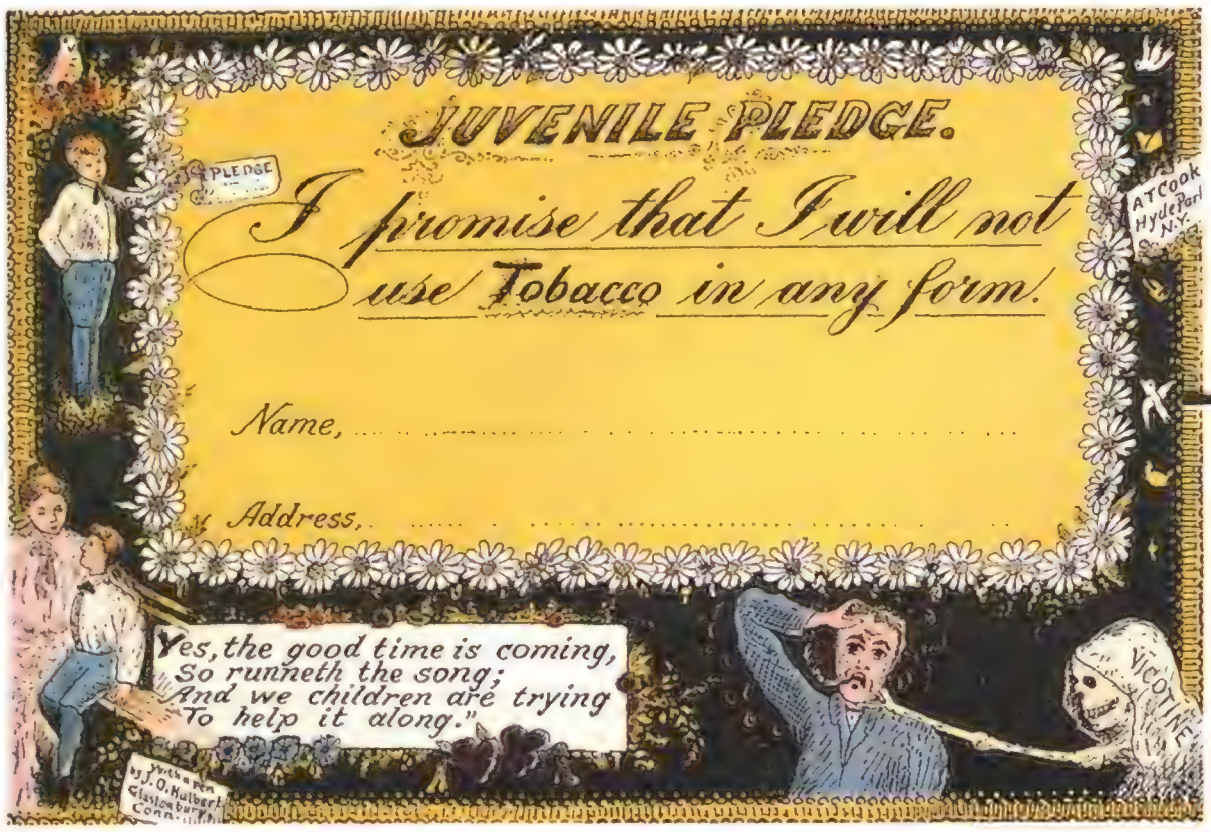
The swift advance of the cigarette after the turn of the century alarmed many people not usually given to social reform movements, among them Henry Ford, Thomas Edison and other businessmen and industrialists. Ford wrote and published an anticigarette tract, "The Case Against the Little White Slaver," in which he disdained cigarette smokers as inefficient at best and inclined to criminality at worst. "If you will study the history of almost any criminal you will find that he is an inveterate cigarette smoker," he wrote. In a 1909 report, "The War On the Cigarette," the *New York Times* credited businessmen with providing the spur for restrictive legislation in eight states. The anticigarette movement was also supported by cigar makers, who were concerned about the cigarette's inroads into their business; and by tobacco dealers, who tended to regard cigarettes as a low-profit nuisance. One dealer applauded the passage of a ban on cigarettes in the state of Washington in 1893 because "I am tired of getting off my stool 250 times a day to sell a five-cent package of cigarettes and then making only 10 cents on the whole lot."

The galvanizing element in the battle against cigarettes was the charge that they corrupted youth. "Unquestionably, one of the most lamentable evils which afflict the rising generation flows from the early use of tobacco," the *New York Times* editorialized. "Lads at school acquire a taste for tobacco by surreptitiously smoking cigarettes—cigarettes which have done more to demoralize and vitiate youth than all the dram-shops of the land."

As a mark of manhood, cigarettes were considerably cheaper and easier to come by than long pants. They were mild, easy to smoke and discreet. Their appeal to the young was further enhanced by the introduction of trading cards and coupons as a marketing device in 1878. The cards usually included a lithograph on one side and explanatory text on the other; each was part of a numbered series, the goal being to collect all the cards in a series. The subjects ranged from "Great Americans" to "Perilous Occupations," but the perennial favorites were "Actresses" and "Beauties." Not a few boys growing up in America at the time received an edu-




Pledge cards were distributed to children in schools and churches. Some antismoking groups emphasized education over legislation.

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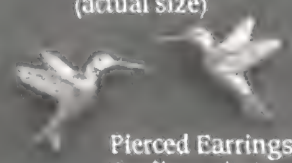

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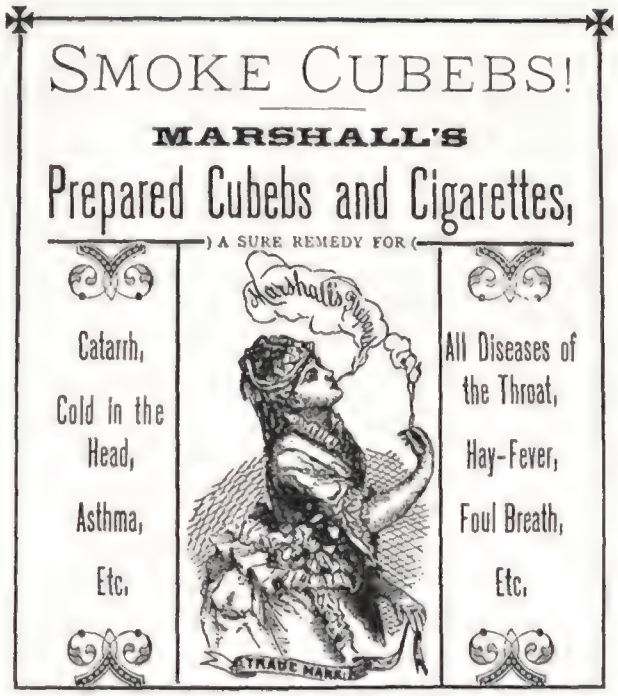


Ad of 1880 ballyhoos dry cubeb berry crushed and smoked as a panacea.

cation in the anatomy of the female form (demurely encased in tights) with the help of Sweet Caporal, Duke of Durham, Cameo and other popular brands.

Efforts to curb smoking by minors served as the opening wedge in the legislative campaign against cigarettes. By 1890, according to one tally, 26 states and territories had outlawed the sale of cigarettes to minors (defined as anything from age 14 to 24). Mindful of the sanctity of the family, a number of states stipulated that cigarettes could be sold or given to minors with parental consent. Penalties for violating the laws varied widely, with the average being a fine of $20-25. South Carolina took the novel approach of providing that half the assessed fine be paid to "the informer of the offense." The law (later imitated by several other states) was written in such a way that a boy could buy a package of cigarettes and then collect a reward for telling on the seller. Some states ordered youthful smokers to reveal the source of their contraband on pain of a fine or jail term. Bracketed with bribes or threats, the laws appear to have been ineffective; at least it would seem so, from the speed with which anticigarette activists adopted other tactics.

In 1892, the reformers petitioned Congress to prohibit the manufacture, importation and sale of cigarettes. The Senate Committee on Epidemic Diseases concluded that only the states had such authority. The committee, however, agreed that cigarettes were a public health hazard and urged the petitioners to seek remedies from state legislatures. By the end of the decade, four states had outlawed the sale of cigarettes to adults as well as minors. The campaign escalated in 1899 when a Chicago group backed by business interests organized the Anti-Cigarette League, which was headed by the indefatigable Lucy Page Gaston—the Carry Nation of cigarettes. By 1901, the league claimed a membership of 300,000, with a paid staff overseeing chapters throughout the United States and Canada.

The campaign was aided to some degree by the heavy-handed tactics of the American Tobacco Company. The company regularly dispatched emissaries to dissuade legislators from voting for anticigarette bills, by weight of largess if not clarity of argument. As an anonymous company executive recalled, "A bill would be introduced to a legislature to prohibit the manufacture or sale of cigarettes; it would be referred to a committee, and our

In 1895 a New York hotel maintained a smoking room for female puffers.

The height of depravity was reached by this smoking demimonde, in 1913.

people would have to get busy and pay somebody to see that it died." The method backfired at times. In 1905, a clumsy attempt at bribery virtually forced the Indiana legislature into prohibiting cigarettes. The measure had been passed by the Senate with the intention of embarrassing certain reform leaders in the House; the House as a whole was expected to hoot it down. However, right before the vote, Representative Ananias Baker dramatically held aloft a sealed envelope and announced that it had been given to him by a lobbyist from the Tobacco Trust, with instructions to vote against the bill. He opened it with a flourish: five $20 bills dropped out. The display seemed to confirm a prediction by the state's largest tobacco dealer, reported in an Indianapolis newspaper a few days earlier, that the trust would "buy up the whole House" before it would permit passage of the bill. Baker left his colleagues little choice but to vote for the bill, lest they be suspected of having been influenced by similar envelopes.

The industry found scant relief in the courts. Although a number of lower courts ruled that anticigarette laws were unconstitutional, the U.S. Supreme Court upheld their validity in an important decision in 1901. The case had been initiated in Tennessee after that state outlawed cigarettes in 1897. Counsel for the American Tobacco Company argued that the law was an unconstitutional interference with interstate commerce. The Tennessee Supreme Court held that the law was constitutional, concluding that cigarettes were not "legitimate articles of commerce," because "they are . . . wholly noxious and deleterious to health . . . an unmitigated evil."

The U.S. Circuit Court overturned the state court but agreed that cigarettes were "an evil of most pronounced character." The U.S. Supreme Court ruled that cigarettes were legitimate articles of commerce, long recognized as such by Congress and taxed accordingly; but that states nonetheless had the right to prohibit their sale, manufacture or use.

The industry fared little better in the court of public opinion. In Seattle, a woman was granted a divorce on the grounds that her husband was an inveterate cigarette smoker. A New York woman took the precaution of

Henry Ford (left) and Thomas Edison both deplored the use of tobacco.

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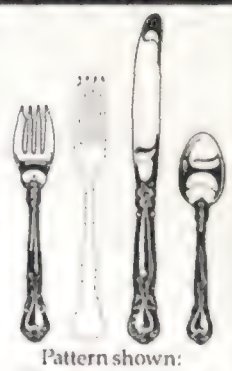

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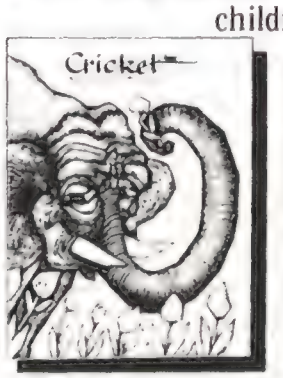


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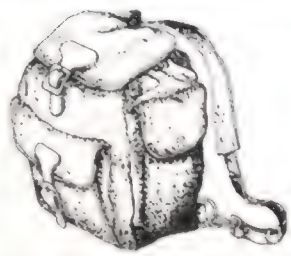

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requiring her fiancé to sign a prenuptial agreement promising never to smoke cigarettes; he also agreed to be kind to his mother-in-law and to beat the carpets every spring without grumbling. Public enmity could also be seen in the growing demand for curbs on public smoking. The *New York Times* endorsed the new Non-Smokers' Protective League of America in 1910, saying, "Anything that may be done to restrict the general and indiscriminate use of tobacco in public places, hotels, restaurants, railroad cars will receive the approval of everybody whose approval is worth having."

Modern couple at turn of the century swap roles in their dining room.

World War I provided the nails for the coffin of the first anticigarette movement. Increased prosperity, the demands of the military and the spread of cigarette smoking among women combined to strengthen the industry while weakening the opposition. Military commanders had long regarded tobacco as essential for the fighting man. "Tobacco is as indispensable as the daily ration," Gen. John J. (Black Jack) Pershing, commander in chief of the American Expeditionary Force, cabled Washington, D.C. "We must have thousands of tons of it without delay." Americans from all walks of life responded to the call. Theaters set up boxes to collect pennies from children and cigarettes from smokers. Celebrities by the score pronounced tobacco a necessity for the defense of democracy. The campaign to send smokes Over There even reached into prisons, where inmates gave up their tobacco rations in the interest of besting the Hun. By the time Johnny came marching home, the once disreputable cigarette had become an almost unassailable symbol of courage, decency and the American Way.

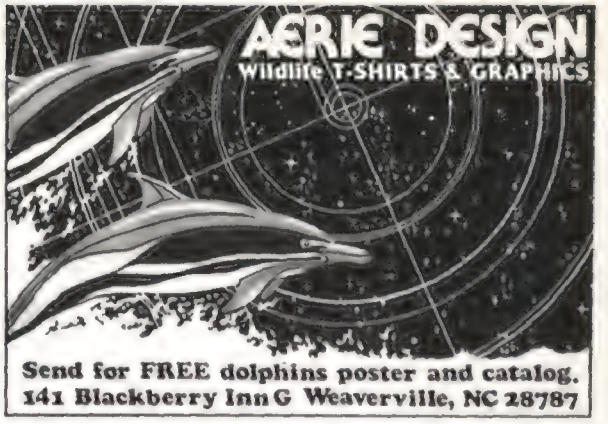
The anticigarette movement acquired an air of futility in the face of this widespread enthusiasm, but it persisted for a while. A few tracts were published during the war, among them "Kaiser Nicotine," which depicted "the deadly cigarette" as a "German ally in the American trenches." The reformers scored a victory in Kansas in 1917, when a 1909 law was broadened to prohibit not only the sale but the advertising of cigarettes. The enforcement mechanism was tightened to stipulate that possession of cigarettes would be considered prima facie evidence of the law. In 1921, an industry tally showed that 92 measures affecting smokers were pending in the legislatures of 28 states. Idaho and Utah banned cigarettes that year. However, the Idaho law was repealed less than two weeks after it was enacted; and Utah's law was repealed at the very next session of the legislature. By 1927, with the legalization of cigarettes in Kansas, the campaign had sputtered to an end.

The increase of national advertising during the '20s helped break down the remaining prejudices against cigarette smoking, particularly among women. With the Depression, the capitalistic cigar increasingly gave way to the democratic cigarette. Few would have argued with the tobaccophile who concluded in 1932 that, "Although the fight between the smokers and nonsmokers still drags on, a

glance at statistics proves convincingly that the latter are but a feeble and ever-dwindling minority."

The cigarette had won the first round. But out of the ashes, as it were, of the old movement has come a new campaign. By the 1980s, states were once again passing antismoking laws; government agencies were issuing restrictive regulations; and the courts were busy with cigarette-related litigation. For much of middle-class America, the cigarette had become a social liability. Smokers retreated to the back of the plane, the back stairs at the office, the back porch at the dinner party. The release of the 1988 Surgeon General's Report on Smoking and Health, equating cigarettes with heroin and opium, brought the movement full circle. No doubt the report would have been taken as vindication by the Rev. M. R. Drury, who predicted a century ago that "the time is not far distant when the use of tobacco will be generally looked upon with disfavor and admit of no apology whatever." On the other hand, an Italian physician may have been closer to the mark when he observed, in 1713, that "This vice will always be condemned and always clung to."

W. C. Fields expresses his opinion of smokers. Although he often lit up a cigar as a prop in performances, he did not inhale it.



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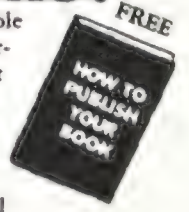

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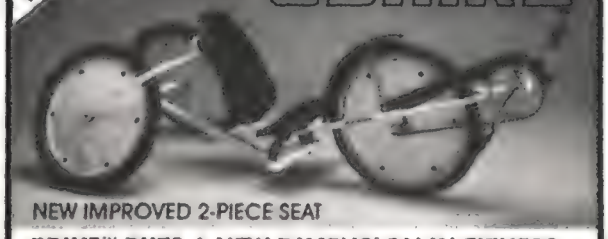
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# *Book reviews*

*In Trouble Again: A Journey Between the Orinoco and the Amazon*
Redmond O'Hanlon
Atlantic Monthly Press, $17.95

In the southernmost, pouchlike tip of Venezuela, between the Orinoco and Amazon rivers, and hard by the Rio Negro, lies a section of the Amazon Basin so remote and jungle-choked that maps of the area are either nonexistent or dangerously inaccurate. Having returned from a difficult journey into the primary rain forests of Borneo, one Redmond O'Hanlon concludes that a well-planned trip into this region would pose "no particular problem."

Who is Redmond O'Hanlon and why is he going to Amazonas? He is natural history editor of the *Times Literary Supplement*, a fellow of the Royal Geographic Society, Oxford educated, a childhood bird-watcher and bird egg collector. He's going into this latter-day Heart of Darkness to locate a mysterious tributary of the Rio Negro, and more privately, to experience again—as must all explorers, past and present—that "sudden, passing, incandescent moment" of discovery, of sighting new things and new places.

The first leg of his journey takes him to Caracas, where a naturalist acquaintance warns him that the Amazon Basin "is not a kind place." Undaunted, our man gathers up a crew of six native guide types—he is accompanied already by one fellow Brit, who immediately tries to teach his new comrades some English slang, insisting that to get angry or upset is to "throw a wobbly." Next stop for the expedition is the frontier village of San Carlos on the Rio Negro, a jumping-off place where permits are granted and the corrugated roofs crack and bang in the midday sun.

O'Hanlon is no novice at this business, not after Borneo; and the self-effacing candor of his journal lends a refreshing, often irreverent tone to events. After all, in these days of helicopters and walkie-talkies and No. 5 All-Purpose Insect Repellent (see page 76), phony heroics are out of place and O'Hanlon is too considerate to offer them. Over the course of the four-month journey, each member of the party comes to know fright and despair, each gets his turn at crotch fungus and diarrhea. In the incessant rain and heat, men succeed and fail without drumroll.

It's apparent early on that O'Hanlon's first love is birds, for hardly a page turns that he doesn't pause to describe some exotic flying creature. For comparison's sake, he carries in his pack a set of Schauensee's illustrated plates of Venezuelan birds. Repeatedly, our


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trip leader shares with us selected excerpts from the journals of explorers who paddled these Amazonas waters a century ago—von Humboldt, Wallace, Spruce, even Darwin. They travel alongside him like paternal ghosts.

But this isn't Walt Disney's jungle that O'Hanlon and his party are disappearing into. There are piranhas and deadly snakes, inescapable hordes of insects; caimans and anacondas rule the river's edge, and the low coughs booming through the night camps issue from the throats of jaguars.

The rivers have lovely names—Casiquiare, Pasimoni, Yatúa—but they can be cruel. On the lower Baria the jungle gradually closes in on the invaders. Waist-deep in black water and pulling their dugout canoes behind them, O'Hanlon and his mates are reduced to hacking a passage through vegetation-clotted streams that have never felt the sun. It is *The African Queen II,* without leeches. Finally, drunk with fatigue and swollen with ant and hornet bites, they lose their way.

But they get out, as you might suspect, at which point O'Hanlon's pal from home throws his own wobbly and grabs the first motorboat back to civilization. Later, in another part of the forest, the party's planned encounter with the isolated Yanomami tribe—which O'Hanlon avidly sought, and the native crew members tried everything short of desertion and forfeiture of pay to avoid—turns out to be more comical than life-threatening. Known locally as the Fierce People, these naked five-foot warriors club one another over the head in contests of manhood, hunt with bow and arrow, dance a lot and fight over women. Not much new here. Welcome to the 20th century, fellas.

O'Hanlon is a savvy writer. He lets the constant action carry his story forward, lets dialogue deliver most of his natural history lectures. There are maps, drawings, photographs, a bibliography. It's good work, and fun. No stuffy pedant, Mr. O'Hanlon, but just the kind of sensitive, gutsy bloke you'd wish to make such a journey with. He'll almost certainly make another, bounce off to some other wild and wondrous corner of the world. You might keep your phone lines open; making up his new crew, he could call. Be sure to take along plenty of No. 5.

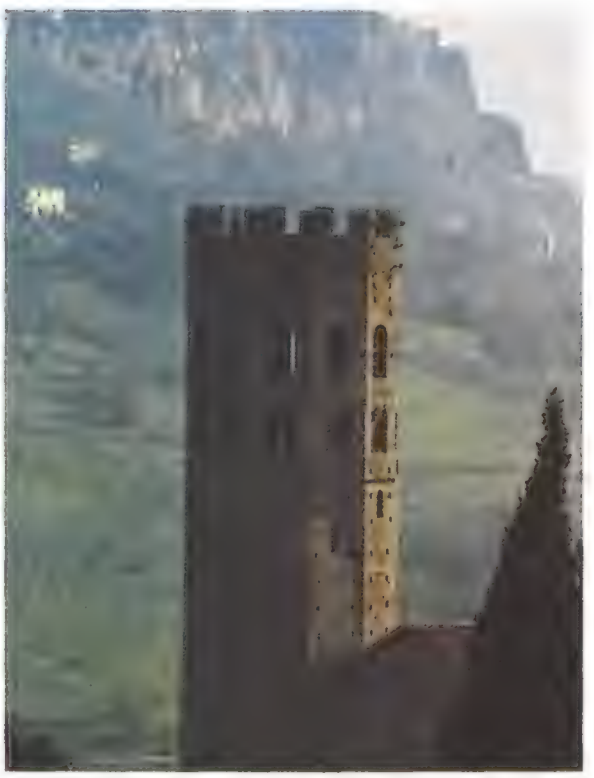
*William Dieter*
Denver novelist

*The Hill Towns of Italy*
Photographs by Richard Kauffman
Text by Carol Field
W. P. Dutton, paper $19.95

This is a very pretty book exactly suitable for the two types of basically sensible people: those on their way to Italy and those who spend their dreaming time dwelling on it. There have been other books on different aspects of the hill towns of Italy. How could there not be? The place is so infinitely enchanting.

This one takes up the subject in general and, generally speaking, visiting these villages and towns can be a heavenly experience. There is in them, from where they are in the land, to what they look like, to what they contain in the forms of architecture and art, to what air and wind and sun have done to them over the centuries, something that visitors have found commonly magical, an atmosphere, a slant of light, a feeling.

While *Hill Towns* is beautiful for the photographs, it is also sensible for the short, knowledgeable and clear text, and it is outstanding for the quotations salted throughout, which add the glory of great creative personalities commenting on the beauties and feel of the place. These range from Goethe to Henry James (whose book *Italian Hours* is a classic of the country) to E. M. Forster to Sean O'Faolain, who spent A Summer in Italy and published a book by that name. There are quotations, apposite to photographs that they exemplify, from Montaigne, Dickens, Edith Wharton and even Hippolyte Taine. Henry James, in his often enough imitated but inimitable way, says "I should, perhaps, do the reader a service by telling him just how a week at Perugia may be spent." And proceeds to advise that "His first care must be to ignore the very dream of haste, walking everywhere very slowly. . . ." and so goes on to ensnare.



With timeless beauty, an Italian hill town appears to float in morning light.

Here, then, are presented these hill towns in two provinces, Tuscany and Umbria. In Tuscany: Siena, San Gimignano, Montepulciano, Pienza, Volterra, Cortona and Arezzo. In Umbria: Perugia, Assisi, Orvieto, Todi, Spoleto and, lastly, Gubbio.

"With half a word's persuasion," writes Mrs. Piozzi (the former Mrs. Hester Thrale of Dr. Johnson fame) in the 18th century, "I should fix here for life. The air is so pure, the language so pleasing, the place so inviting." You can easily see why the great Samuel Johnson placed so high a value on her good sense.

Always, go to Italy if you can. Always, read about it, if you can't. This book will serve you very well, either way.

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*The Missionaries*
Norman Lewis
McGraw-Hill, $17.95

In 1968 the *Sunday Times* sent British journalist and novelist Norman Lewis to Brazil to investigate the condition of the Indians there. What he found was appalling: a people nearly exterminated by outside forces. His report, published as "Genocide in Brazil" and at the time the longest article ever to appear in the *Sunday Times Colour Section,* attracted international attention, brought about changes in Brazilian law, and helped bring about the founding of Survival International, an organization dedicated to protecting aboriginal peoples around the world.

Lewis' travels often have included contact with peoples still relatively untouched by so-called civilization, but those Indians stayed with him, appearing again in his 1972 novel, *Flight From a Dark Equator.* And in 1985, introducing a collection of his journalism and travel essays called *A View of the World,* Lewis termed that original article "the great divide in my writings,

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the swing round in my viewpoint . . . the most worthwhile of all my endeavours." Now that article, with two additional decades of sad experience, forms the basis for Lewis' latest book. *The Missionaries* names the villains—primarily members of the Summer Institute of Linguistics and of the New Tribes Mission—and documents a case against them as killers of culture and art and language and music and health and, not least, innocence.

Consider the Panare, for example, a beautiful and peaceful people living deep in the remote forests of South America. For them the outer world of stress and conflict does not exist, and cannot even be described in their language, which lacks words for such concepts as sin, guilt, punishment and redemption. Such people posed a difficult challenge to the fundamentalist Christian missionaries of the New Tribes Mission. How can a man who has never lacked for any of his simple needs be made to store up invisible treasure for future life? How can he consider questions of greed, dishonesty, betrayal, when his language lacks even a word for profit? And what about guilt? A meaningless word to the Panare.

"But," notes Lewis in the most quietly horrifying and moving pages of the book, "the basic sense of guilt was at the heart of the missionary problem and it was something that had to be manufactured." And so the missionaries manufactured guilt. For the Panare they made a special translation of Scripture: "The Panare killed Jesus Christ / because they were wicked. / Let's kill Jesus Christ / said the Panare." These decent people, the missionaries insisted, were implicated in a crime. What would happen now? "God will burn you all,/ burn all the animals, burn also the earth, / the heavens, absolutely everything. / He will burn also the Panare themselves."

A comet shooting across the skies, conveniently predictable by the missionaries, had terrified the Panare within living memory. God, they were beginning to understand, might not let them off so easily the next time. " 'Do you want to be roasted in the fire?' asks God. / 'Do you have something to pay me with / so that I won't roast you in the fire? / What is it you're going to pay me with?' " And the price of being spared became clear: complete rejection of their own traditional customs and culture, and unquestioning submission to the will of the missionaries.

The naked and healthy hunter of the forest became a sickly, hungry, helpless creature in Christian rags, cultureless and adrift in an alien world. The Indian woman, led out of the forest but abandoned in a settlement, became a prostitute. The missionaries, selectively blind to reality, saw only a heathen made a Christian and that Christian saved. "These Indians," writes Norman Lewis, "had suffered to the full the processes of what is now spoken of as acculturation. They had walked with the Lord, and come to the end of the road."

What an old, familiar and sad story this is. But this time, as Lewis tells it, there is a difference. "In the space of a mere thirty years so much has been swept away," he writes. The Indians lose their lives. "In another thirty years no trace of aboriginal life anywhere will have survived." And we lose Indians. Writing with the cool distance of an observer stunned with horror, Lewis makes clear how such a thing can happen.

*Alan Ryan*
New York journalist and novelist

*Changing Habits: A Memoir of the Society of the Sacred Heart*
V. V. Harrison
Doubleday, $18.95

For most American Roman Catholics, the title wittily sums up the profound changes unleashed within the Catholic Church by the Second Ecumenical Council to be held at the Vatican, 1962-65, popularly known as Vatican II.

Others may need brief instruction. Vatican II was revolutionary just by virtue of its having been called, as it was by Pope John XXIII as the key part of his announced program of bringing the church up to date. Vatican I (1869-70), with the Italian Army at the gates of Rome about to end the 1,500-year rule of Central Italy by the popes, had proclaimed the infallibility of the pope. It had been widely assumed that Vatican I was the last Council, since matters formerly decided by Councils would now be decided by the pope with the assistance of the Holy Spirit, Third Person of the Holy Trinity (the others being God the Father and God the Son, or Jesus Christ).

Vatican II proceeded to be revolutionary indeed, in terms of the rigidly conservative Roman Catholicism that had emerged from the shock of the Reforma-

Madeleine Barat mixed cloistered life with teaching in Society of Sacred Heart.

tion led by Martin Luther, Henry VIII of England and John Calvin.

First, the Council introduced reform of the liturgy, the various rituals of the church, ranging from the mass to private but prescribed prayers for priests and nuns. This led eventually to the mass in English (or French, or Polish or Swahili) and the loss of one of the great structures of the Latin language and the Hebrew Psalms and other prayers.

The Council also decreed that lay Catholics should enjoy a greater role in the church than the pray-and-pay status long their lot. It was also ruled that nuns should be "liberated" from their long silence and should have some say in their own institutional, collegial and individual futures. This led to the scrapping of the habits, or special dress modes, of most religious orders in favor of, at first, a version of the suits worn in those days by airline stewardesses.

That is the point at which the epoch-making reforms of Vatican II coincided with the life of the author, V. V. Harrison, and her experience as a student of the Society of the Sacred Heart, widely regarded as running the best schools and colleges for Catholic women in the country, and profoundly affected by those reforms.

Harrison must have been something of a hard case herself, since the society's prep school, Eden Hall, outside Philadelphia, was the third boarding school in as many years that she was put into by her parents. She was also, at best, a halfhearted Catholic, a child of mixed marriage who writes, "Attending Mass every Sunday was like watching an incomprehensible movie over and over again. I knew . . . what was coming next, but I did not understand the plot."

She hated nearly everything about the place, but did make friends with a couple of classmates and even a couple of nuns. The night before graduation, to her astonishment, she heard herself saying "I don't want to leave."

This combination of remembered love and hate was probably perfect for the job Harrison assigned herself as a freelance Washington writer: to put together a brief history of the society in France (where it was founded in 1800) and America, with an account of her own experience, and an informal survey of the changes and the reactions to the changes that she found in the society since her departure from Eden Hall almost 30 years ago.

The change of the habits led to nuns leaving the order and to those who stayed wearing everyday clothes of the time: blouses and skirts or slacks. The cloistered atmosphere has completely disappeared. Nuns live "off campus," as it were, in small groups or alone, and pursue their ministering tasks probably to greater broad social gain than when their main mission seemed to be the high-class education of high-class young ladies. Scholastic and other discipline has slackened.

Better or worse? Anyone's choice. Obvious answer: both.

The wider significance of all this goes far beyond the society; it reaches throughout the church, as may be seen in such recurring conflicts as those between the Vatican and the American bishops, and between Catholic University and some of its theologians.

The basic issue of females in male society, which is really what the book is about, unsettles everything from private men's clubs to political parties, and most assuredly the ecclesiastical establishments based on the idea of the God-given superiority of males.

*Changing Habits*, with humor, compassion, and considerable lightly worn historical knowledge and contemporary research, addresses one specific example of the gender revolution we are all involved in, even popes and Presidents.

*Frank Getlein*
Author and critic


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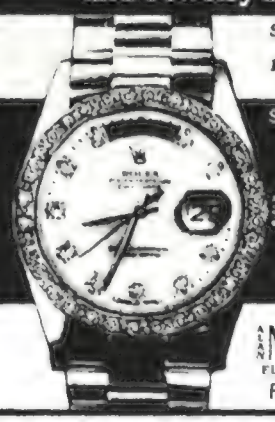
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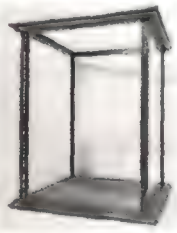
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# *Additional reading*

**Horizons** (p. 8)

"Young scientists discuss recent advances, future challenges" by Rudy M. Baum, *Chemical & Engineering News*, March 20, 1989

"Science teaching in the spirit of science" by Lynn B. Jenkins and Walter B. MacDonald, *Issues in Science and Technology*, Spring 1989

*Science & Engineering Indicators—1987*, National Science Board (Washington, D.C.), 1987

"Education of the next generation of nonscientists" by Frank H. Westheimer, *Chemical & Engineering News*, July 4, 1988

**Zoo centennial** (p. 26)

*A Zoo for All Seasons: The Smithsonian Animal World*, Smithsonian Exposition Books, 1979

*Keepers and Creatures at the National Zoo* by Peggy Thomson, Thomas Y. Crowell, 1988

**Portland Vase** (p. 52)

*The Portland Vase* by D.E.L. Haynes, British Museum Publications Ltd. (London), 1975

*Glass of the Caesars* by Donald B. Harden, Hansgerd Hellenkemper, Kenneth Painter and David Whitehouse, Olivetti (Milan), 1987

"Sir William Hamilton and the Portland Vase" by Geoffrey Wills, *Apollo*, September 1979

*Masterpieces of Wedgwood in the British Museum* by Aileen Dawson, Indiana University Press, 1984

**Philippe Egalité** (p. 66)

*Le Prince Rouge* by Andre Castelot, Editions Rombaldi (Seville, Spain), 1974

*Prince of the Blood* by Evarts S. Scudder, Collins (London), 1937

*Citizens: A Chronicle of the French Revolution* by Simon Schama, Knopf, 1989

*Origins of the French Revolution* by William Doyle, Oxford University Press, 1980

*The French Revolution* by Georges Pernoud and Sabine Flaissier, translated by Richard Graves, Putnam's, 1961

**Insect repellents** (p. 76)

"A compendium of inorganic substances used in European pest control before 1850" by Allan E. Smith and Diane M. Secoy, *Journal of Agricultural and Food Chemistry*, Vol. 24, No. 6, 1976

"Repellents" by V. G. Dethier, *Annual Review of Entomology*, Vol. 1, 1956

"The effectiveness of permethrin and deet, alone or in combination, for protection against *Aedes taeniorhynchus*" by C. E. Schreck, D. G. Haile and D. L. Kline, *American Journal of Tropical Medicine and Hygiene*, Vol. 33, No. 4, 1984

**Women's baseball** (p. 88)

"Seasons In the Sun" by David Young, *Women's Sports*, October 1982

"Glamour Ball" by Jay Feldman, *Sports Heritage*, May/June 1987

**Biomechanics** (p. 98)

*Life's Devices: The Physical World of Animals and Plants* by Steven Vogel, Princeton University Press, 1988

*Axis and Circumference* by Stephen Wainwright, Harvard University, 1988

"Aerodynamics of Wind Pollination" by Karl J. Nicklas, *Scientific American*, July 1987

"Trunks, Tongues, and Tentacles: Moving with Skeletons of Muscle" by Kathleen K. Smith and William M. Kier, *American Scientist*, January/February 1989

**Antismoking campaigns** (p. 107)

*The Mighty Leaf: Tobacco Through the Centuries* by Jerome E. Brooks, Little, Brown, 1952

*Goodbye To All That* by Harris Lewine, McGraw-Hill, 1970

*The American Cigarette Industry: A Study in Economic Analysis and Public Policy* by Richard E. Tennant, Archon Books, 1971

*Cigarettes: The Battle Over Smoking* by Ronald J. Troyer and Gerald E. Markle, Rutgers University, 1983

# *Smithsonian highlights*

**Planning a Smithsonian visit?**

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**Castle and Freer closings**

The Castle, under renovation for the new Information Center, is closed to visitors until late summer. The Freer Gallery of Art is closed until 1992.

**Summer offerings**

A number of free activities are scheduled throughout the Smithsonian this month. On the Mall, the annual Festival of American Folklife, June 23-27 and June 30-July 4, focuses on Hawaii, American Indian and Caribbean culture and the French language: 357-2700. At the Zoo, Sunset Serenades on Lion House Hill showcase various musicians on July 6, 13, 20, 27; 6:30-8 P.M.; call [illegible]-4717. The Sackler Gallery features an extensive program of family activities, including programs in conjunction with *Yani: The Brush of Innocence*, weekdays at 12:30 P.M.; call 357-2700. At the S. Dillon Ripley Center, performances and activities accompany an exhibit that re-creates the Caribbean street festival; call 357-2700.

**Special July exhibits and events**

**Renwick Gallery**
*The Boat Show: Fantastic Vessels, Fictional Voyages* (through August 6) Renditions of fanciful ships by 16 contemporary American artists. See *Highlights continued*, page 125.
*Bound to Vary: Billy Budd, Sailor* (through August 6) Unique handmade bindings for a limited edition of Melville's classic.

**Anacostia Museum**
*The Real McCoy: African-American Invention and Innovation, 1619-1930* (through November 5) Black inventors and anonymous innovators.

**National Museum of African Art**
*Gold of Africa: Jewelry and Ornaments from Ghana, Côte d'Ivoire, Mali and Senegal* (through August 28) A celebration of the goldsmith's art.
*The Essential Gourd* (through January 4) Nigerian decorative techniques.

**International Gallery, S. Dillon Ripley Center**
*Caribbean Festival Arts* (through February 15) An exhibit of costumes, music, videotapes, photographs and performers evokes the Caribbean street festival.

**National Museum of American Art**
*The Art of Paul Manship* (through July 23) An American master rediscovered.
*Photography of Invention: American Pictures of the '80s* (through August 13) Images by 90 experimental practitioners.

**Arthur M. Sackler Gallery**
*Yani: The Brush of Innocence* (through October 22) Paintings by the internationally renowned 13-year-old artist.
*Timur and the Princely Vision: Persian Art and Culture in the Fifteenth Century* (through July 6) Creations by artisans of the Timurid dynasty.

**National Portrait Gallery**
*Isamu Noguchi: Portrait Sculpture* (through August 20) Subjects from George Gershwin to Clare Boothe Luce.
*The First Federal Congress* (through July 23) A 200th-birthday commemoration featuring portraits, memorabilia.

**National Museum of Natural History**
*Inside Active Volcanoes: Kilauea and Mount St. Helens* (July 6-September 24) The inner workings of two fire mountains, featuring murals, instruments and interactive computerized video displays.
*Orchid Illustrations by Regina Olson Hughes* (through August) Botanical drawings by the illustrator and artist.


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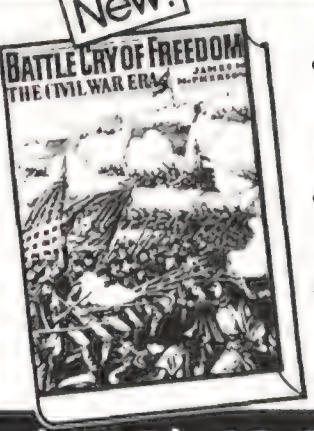


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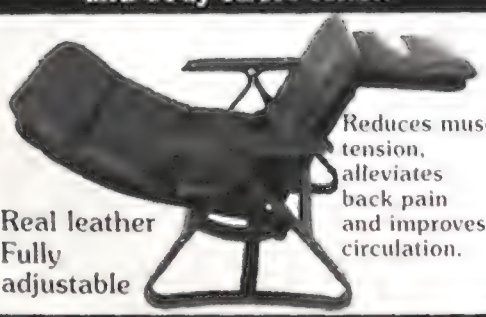

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*John Muir's High Sierra: A Watercolor Diary by Tony Foster* (through August 13) The Cornish artist's images, painted during an eight-week hike in 1986.

**Hirshhorn Museum & Sculpture Garden**
*Robert Moskowitz* (through September 17) The first major retrospective for the New Image painter.
*Directions: Ericka Beckman* (through July 23) Sound-and-light installation with photographs, showcasing the work of the New York filmmaker and sculptor.
*Buster Simpson "WORKS"* (through July 23) An outdoor commission by the Seattle-based environmentalist-artist.

**National Museum of American History**
*American Television from the Fair to the Family, 1939-1989* (through April 1990) Artifacts tracing the rise of television in American culture.
*Sesame Street* (through October 15) A look back over 20 years.
*The Way to Independence: Memories of a Hidatsa Indian Family, 1840-1920* (through September 30) A chronicle of American Indian experience.

**National Air and Space Museum**
*Reflections on Apollo 11* (opens July 14) Paintings, drawings and prints interpreting the moon-landing mission.
*Aeropittura Futurista: Images of Flight in Italian Art, 1913-1942* (through October 2) The conception of flight through the lens of Italian Futurism.
*Beyond the Limits: Flight Enters the Computer Age* A new gallery explores the computer revolution in aerospace.
*Hubble Space Telescope* A full-scale test model of the telescope that will be launched aboard a space shuttle.

**Cooper-Hewitt Museum** (New York)
*L'Art de Vivre: Decorative Arts and Design in France, 1789-1989* (through July 16) More than 400 objects created by French artisans.

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**Lecture and Seminar Program**

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**Resident Associate Program**

To become a Resident Associate, or for fee and ticket information, call 357-3030.
*Inside Volcanoes* (July 5; 8-9:30 P.M.) Smithsonian geologist Richard Fiske introduces the premier film *Inside Hawaiian Volcanoes* and leads a preview of the new Museum of Natural History exhibit, "Inside Active Volcanoes."
*Liberté, Egalité, Fraternité: The Legacy of the French Revolution* (July 13; 8 P.M.) Johns Hopkins historian Robert Forster on the revolution.
*Trinidad and Tobago Steel Band of Washington, D.C.* (July 26; 7 P.M.) Concert featuring calypso to classical.

**Smithsonian Institution Traveling Exhibition Service**

SITES organizes and circulates exhibitions to cities throughout the United States and abroad. To sponsor a show in your community, write SITES, Smithsonian, Washington, D.C. 20560. Here are some July exhibits:
Denver, Colorado (July 8-September 3) *Zoo Ark*, Denver Zoological Foundation.
Fort Madison, Iowa (July 22-August 20) *After the Revolution: Everyday Life in America, 1780-1800*, City Hall.
Madison, Georgia (July 8-November 12) *What Style Is It?*, Madison-Morgan Cultural Center.
Winston-Salem, North Carolina (July 1-30) *Haiti: The First Black Republic and Its Monuments to Freedom*, Delta Art Center.

# Vessels borne on fantasy

"Somehow," says the Renwick Gallery's assistant curator Jeremy Adamson, "it seemed the idea of ships was in the air—we realized they constituted a kind of unheralded, popular motif." The gallery had just acquired sculptor Larry Kirkland's imaginatively rendered *Soulboat*—all 36 feet of her (below). Michael Shaughnessy had approached the museum in search of exhibit space for his 28-foot *Hayboat*, a winsome vessel crafted of recycled wood, bailing twine and, yes, specially fumigated hay direct from a real barn.

Both of these pieces became part of "The Boat Show: Fantastic Vessels, Fictional Voyages," the Renwick's offering of ships that originated not at the dockyard but in the artist's studio. Five of the large-scale pieces were actually constructed on-site by artists who converged from around the country to wield hammer and saw in the museum's spacious downstairs galleries.

Drawing on sources in myth, legend, history and their own untrammeled imaginations, 16 artists created 18 vessels that call up journeys through time and through space, associations that range from Greek myth to 19th-century ancient mariners.

The show continues at the Renwick through August 6.

*Kathleen M. Burke*

Larry Kirkland's multi-oared hanging sculpture, *Soulboat*, was inspired by the artist's observation of Southeast Asian fishing vessels during his travels.

In his *Valhalla Vertical Triptych*, Robert Huban invokes Norse afterlife.

John Roloff built his *Vanishing Ship/ Greenhouse for Lake Lahonton* on-site.

*River Styxx*, one in series of basket-vessels made by Lillian Elliott and Pat Hickman, takes title from Greek underworld river and rattan sticks in frame.

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Grand Canyon *August 18-27*: New section of this raft trip added by popular demand.

**NEW** Romance of the Gold Rush *September 2-10*: From Sacramento to San Francisco, sail aboard the tall ship *Californian.*

White Mountains of New Hampshire *September 11-20*: Hike to panoramic views.

California—Big Sur to Yosemite *September 13-22*: Easy scenic hiking.

**NEW** Detroit Auto Barons *September 14-17*: Visit their estates and a modern factory.

**NEW** Brooklyn with a Bang *September 14-17*: Includes *Jerome Robbins' Broadway.*

Appalachia *September 15-23*: Kentucky artists and writers introduce mountain heritage.

**NEW** Columbia River Cruise *September 21-30*: Sail from Victoria along the coast to Portland, up the Columbia to the Snake River.

Bryce, Zion and the North Rim *October 4-13*: Hiking trip for all levels.

San Antonio-Austin *October 7-14*: Discover a rich mix of Hispanic and Anglo cultures.

Okefenokee *October 31-November 5*: Canoe in a wildlife refuge; for novice or expert.

**NEW** American Treasures—Colonial to Contemporary *November 17-20*: New York weekend to focus on American decorative arts.

Christmas programs Asheville, Santa Fe or Washington, D.C.

Everglades *January 30-February 7*: Canoe the Ten Thousand Islands.

## Foreign Study Tours

Baltic Passage *July 28-August 15*: Cruise to Denmark, Sweden, Finland, Leningrad.

**NEW** Lena River-USSR *July 28-August 16*: Exclusive cruise through Siberia.

**NEW** Voyage to Sumatra and Java *August 1-17*: Visit Singapore, Jakarta, Borobudur.

Austria by Train *August 3-16 or 17-30*: From Vienna to Graz, Badgastein and Innsbruck.

Kenya Wildlife Safari *August 3-20*

Trinity Seminar *August 11-26*: Study rare books, ancient manuscripts in Dublin.

Voyage to Greenland and Hudson Bay *August 19-September 4*: Cruise to the Arctic Circle —natural history, Inuit culture.

Mongolia *August 20-September 18*: Explore the exotic land of Genghis Khan.

People's Republic of China New and repeat tours in late summer and fall 1989: Silk Road, Taklimakan Desert cities, Shanghai seminar and more.

Countryside tours Space still available in fall programs in Hungary and Switzerland.

Himalayan Kingdoms *September 1-22*: Explore the fascinating world of Ladakh, Nepal and Bhutan.

Canadian Rockies *September 6-17 or 19-30*: Glorious hikes in Banff, Jasper, Lake Louise.

Indonesia *September 7-28*: In-depth look at culture, nature in Sumatra, Java and Bali.

Russia's Golden Ring *September 9-23*: Moscow, Leningrad and charming ancient towns.

Gardens of Ireland *September 10-24*

Heart of Asia *September 12-October 9*: Cross the USSR and China on epic tour along the ancient Silk Road. Goes around the globe.

Yugoslavia *September 12-24*

Iberian Ways *September 12-26*: Trace the history and culture of Portugal and Spain.

Ireland Walks *September 14-26*

Seine Cruise *September 15-28*: Explore treasures of Flanders, Normandy and Paris.

Oxford Seminar *September 16-30*: Smithsonian's 11th year at this historic university.

Edinburgh and the Scottish Countryside *September 17-30*

Istanbul and the Aegean *September 27-October 9*: Cruise on the *Sea Cloud.*

Orinoco-Amazon Voyage *October 1-19*: For Contributing Members.

Gardens of Italy *October 4-15*: Botanical showplaces from Lake Maggiore to Vicenza.

Japan Journey *October 7-19*: Cultural overview in Kyoto, Tokyo and the countryside.

Australia-New Zealand *October 22-November 14*: Natural history, native culture.

Mexico-All Souls' Day *October 26-November 8*: Observe village celebrations, customs.

Winter Interludes Spend ten days in Paris, London, Venice, Vienna, Barcelona, Lisbon, Prague or Kyoto.

Argentina *November 12-27*: Explore fantastic natural and historical diversity.

Egypt Seminar *November 14-December 1*: Lectures in Cairo and a five-day Nile cruise.

Fiji *November 18-30*: Thanksgiving in a tropical paradise.

Smithsonian Christmas Holiday Stay in Canterbury, Winchester or Switzerland.

Siberian Winter Odyssey *January 10-27*

South America Voyage *January 17-February 4*: Around the Horn on the *Seabourn Spirit.*

India Wildlife Safari *January 23-February 20*: View rare species of birds and animals.

Kenya-Tanzania Wildlife Safari *January 25-February 11*: A unique journey to East Africa.

Mesoamerican Study Programs *January and February*: Yucatán, El Tajin or Guatemala.

**Write to Smithsonian National Associate Program, Washington, DC 20560 or call (202) 357-4700 for tour brochures, (202) 357-1350**

## SMITHSONIAN-STYLE

## Smithsonian Seminars

Join fellow Associates who share your special interests. Take part in seminars with Smithsonian curators and guest experts.

**Oshkosh, Wisconsin** *September 21-24*
Learn techniques of aircraft restoration during lectures and hands-on workshops led by specialists from the Air and Space Museum and the EAA Air Adventure Museum in Oshkosh.

**Santa Fe, New Mexico** *October 10-15*
Study Hispanic, Indian and Anglo art or learn about archaeological discoveries in the Southwest during sessions taught by Smithsonian faculty and local scholars.

## Research Expeditions

Contribute your time, talent and financial resources to Smithsonian research. Work with curators at Washington, D.C. museums and archives, or at field sites around the country and the world.

### Creating Aerospace Curricula
**Washington, D.C.** *July 9-21*
Using galleries at the Air and Space Museum for inspiration, teachers (K-12) help education staff develop innovative curricula for school groups.

### Air and Space Archival Treasures
**Washington, D.C.** *July 23-August 4*
Help archive historic documents and films at the Air and Space Museum and at the Paul E. Garber Facility.

### Dynamics of an Active Volcano
**Costa Rica** *October 1-13 or 15-27*
Monitor Arenal Volcano's eruptions and study their effect on surrounding rainforest vegetation.

### The Horse in Crow Indian Culture
**Billings, Montana** *August 14-21, 1990*
Photograph, interview and record the annual Crow Fair festivities along the Little Bighorn River.

**Expeditions for 1990** Watch this column for details. Participate in archaeology fieldwork on the Caribbean island of Montserrat or in Zaire. Assist curators with archival research at the Air and Space Museum or with collections storage at the Museum of Natural History. Another project is to help document the Smithsonian's Folklife Festival.

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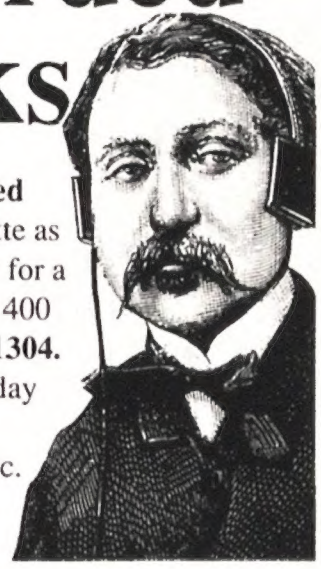

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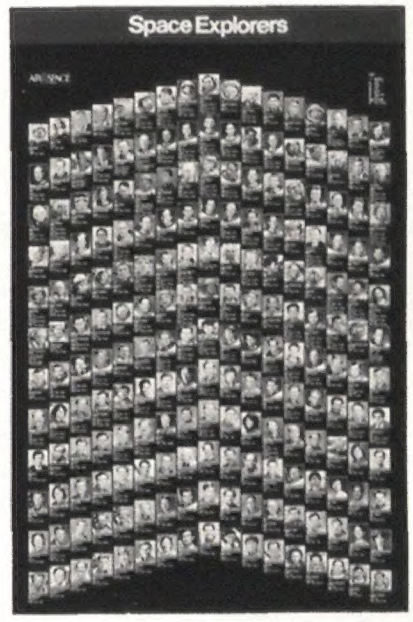


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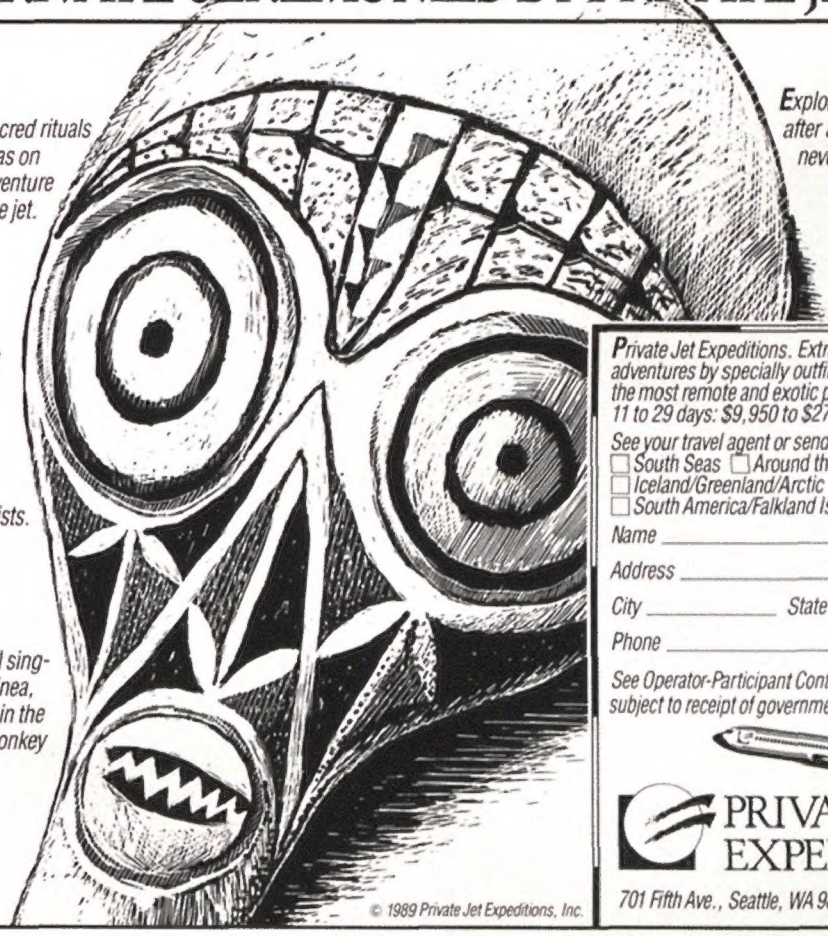

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*By Judy Harkison*

# *I was a flirtatious backwalker for the CIA*

I decided to start my self-improvement with the Art of Flirting. "By learning to flirt," the course catalog promised, "you will learn to get anything or anyone you desire. Cope with speeding tickets, master office intrigue, attract attention."

It was time, I thought, to learn what everybody else already knew, so with only a touch of trepidation, I joined 30 very normal-looking people in my "class," a hotel conference room. The flirting instructor, Kathy, asked each of us why we were there.

A salesman declared that his boss sent him to develop charm. A young man said he'd stumbled in, thinking this was a class in beer tasting. Another male volunteered that he just wanted to see what the enemy was up to.

First we took up "frontal bumping," which is slamming into a shopper and helping him pick up his packages or, slightly more subtle, dropping a canapé on a target's sleeve at a cocktail party, and then helping clean off the mustard stains. Then came "Help me, help me," with its directional subdivision: "Could you tell me how to get to . . .?" Said Kathy, "Go to a big hardware store on Sunday afternoon. When you spot someone, step up and say, 'I'm hanging a plant. What size drill bit should I use?'"

Kathy was full of ploys. "Ask at the airline check-in counter to be seated next to the most attractive man/woman on the plane. Or pretend you're an artist and say, 'Do you mind if I make a sketch?'" In bars these days it is de rigueur for a woman to send a drink to a strange man. Men, it appears, now send roses with a business card, one rose per pickup. According to Kathy, the man may have a half-dozen roses in his car and is likely to be going from bar to bar. (With 1,003 roses a fellow could become a regular Don Giovanni!)

"The secret is eye contact," said Kathy. "Hold the glance long enough to feel uncomfortable. Be ready with a clever opening remark."

At the bus stop the next day I was ready. When a handsome stranger walked up, looking a bit confused, I stepped over and ventured, "You look like you need help." "No," he answered, but went on to chat with me for ten minutes. We exchanged phone numbers. "Oh, boy," I thought. "A piece of cake." (Neither of us ever called.) In the supermarket, smiling devilishly, I asked a tall blond eyeing some lettuce how to choose a ripe melon. "I don't know," he said, backing away as if afraid of being mugged, "my wife usually buys them."

Flirting instruction was conducted by the Learning Annex, founded by Bill Zanker, who says he gets ideas for courses from listening to people's fears and fantasies. Since Zanker is a multimillionaire at 34, I decided to try another course. Passing over Sexual Secrets of the Orient, I briefly considered Winning at Blackjack, but began to wonder if it could work for someone who can never remember whether an ace is 1 or 11 and has trouble adding 9 and 7 quickly.

Finally I settled on Careers in Covert Operations offered through an organization called First Class Inc. When I got to class nobody was wearing a trench coat, but the instructor—I'll call him David—turned out to have been the Central Intelligence Agency's chief of Latin American operations. He was tall and lean, with a strong chin. (Did he pack a Walther PPK and insist that his martinis be "shaken, not stirred"?)

To engage in undercover work for Uncle Sam, David said, you must first master the jargon. A "cratologist," we were gravely told, is an expert on crates. "Dangles" seemed more intriguing, since the word describes human bait used to get the attention of enemy agents. ("What do you do for a living?" "Well, I used to be a dangle, but then I put on weight.")

How do you get a job? "The CIA has a hotline," David answered. "Look in the phone book. In one year about 20,000 people apply for a small fraction of that number of jobs. But if your daddy is a Senator, it's a lot easier."

Later I opted out of Handywoman 101 and Beginning Rock Climbing in favor of Chinese Backwalking. The instructor, Jack, has "walked on hundreds of backs." (Did people snarl at him, "Get off my back!" I wondered.) Backwalking, Jack explained, is part of an ancient Chinese acupressure massage. He demonstrated by placing his right foot on a student's pelvis and his left on the spine, while holding on to the back of a chair to counterbalance his weight. Then he "walked" his left foot down the spine to the sound of bones cracking. "Oh, that always happens," said Jack.

Soon we students set to work. "I kind of like the idea of somebody walking all over me," a small, lean woman said, giggling. "Ouch, that hurts!" cried another victim. "Careful now," said Jack. "My insurance doesn't cover you guys."

When we filed out the door, Jack cheered us on: "Now get out there and start walking on backs. You'll be the hit of the party!" I couldn't wait to combine Backwalking with Advanced Flirtation.

The first attempt was with a guy at my gym, an unmarried ex-marine. I stepped up on him gingerly and he started to laugh, then squirm, and finally he shook so much I fell off. I had forgotten to ask if he was ticklish.

Thoreau once said, "If I knew somebody was coming to see me expressly to do me good, I'd run for my life." From now on that goes for self-help, too.

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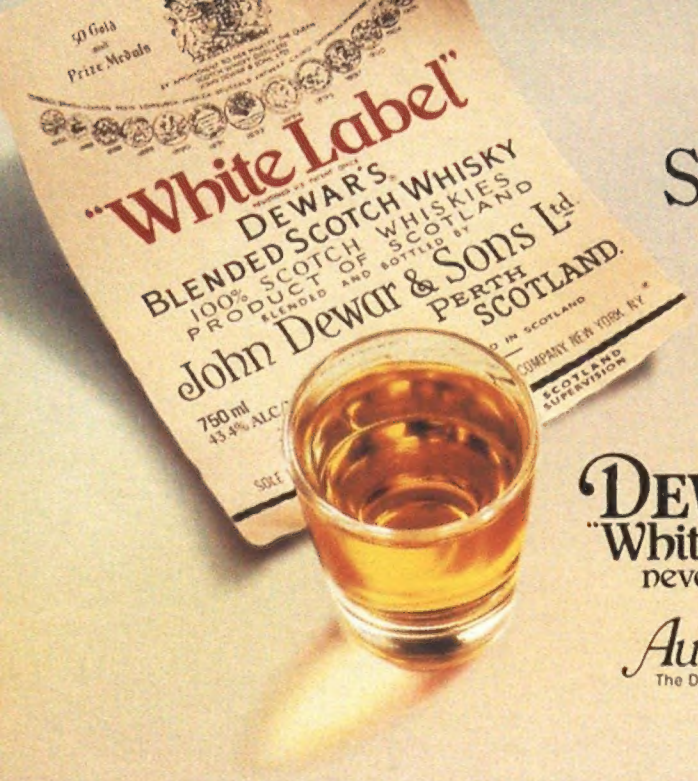


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